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BUREAU OF SHIPS GROUP TECHNICAL INSPECTION REPORT

366723

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Classification (Cancelled) (Changed to Security Information)
By Authority of JOINT CHIEFS OF STAFF JCS 1795/36 DATED 15 APRIL 1949
By [redacted] Date 22 SEP 1953

U.S.S. RALPH TALBOT (DD 390)

TEST ABLE

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BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT

Director
Defense Atomic Support Agency
Washington, D. C. 20301

APPROVED:

F.X. Forest,
Captain, U.S.N.

SECRET

USS RALPH TALBOT (DD390)

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U.S.S. RALPH TALBOT (DD 390)

SHIP CHARACTERISTICS

Building Yard: Boston Naval Shipyard.

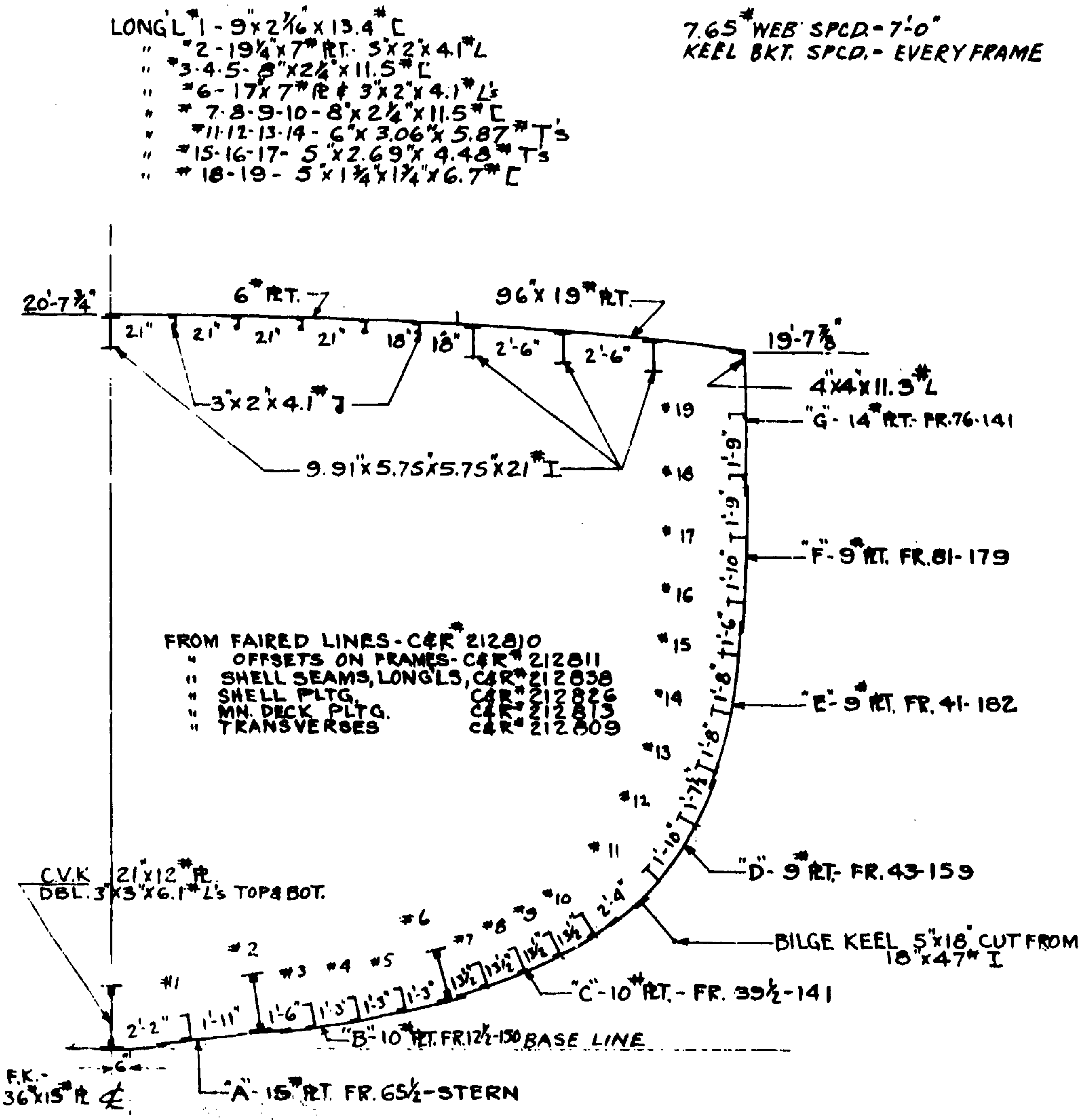
Commissioned: 14 October 1937.

HULL

Length Overall: 341 feet 4 inches.
Length on Waterline: 334 feet 0 inches.
Beam (extreme): 35 feet 6 inches.
Depth (molded at side, to main deck, amidships): 19 feet 7 7/8 inches.
Drafts at time of test: Fwd, 11 feet 9 inches.
Aft. 12 feet 0 inches.
Standard displacement: 1,500 tons.
Displacement at time of test: 2,018 tons.

MAIN PROPULSION PLANT

Main Engines: Two sets of G.E. Turbines are installed in ship. One set per shaft.
Reduction Gears: Two sets of double reduction are installed, one per turbine set.
Main Condensers: Two are installed in ship.
Boilers: Four boilers are installed in ship. Type: Babcock and Wilcox and Foster Wheeler. 400 psi-guage - 700° F.
Propellers: Two are installed.
Main Shafts: Two are installed.
Ships Service Generators: Four are installed in ship. Two 132 K.W. - A.C. sets, and two 40 K.W. - D.C. sets.



MIDSHIP SECTION FR. 96

TEST A

SECRET

USS RALPH TALBOT (DD 390)

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

There is no flooding and consequently no change in drafts or list.

(b) Structural damage.

HULL

There is slight dishing of the main deck between frames 147 and 179 with a permanent deflection of about 3/8 of an inch. This is accompanied by slight distortion of associated transverse and longitudinal girders and supporting stanchions. There is evidence of some increase during the test of previous damage to the shell plating on the starboard side and around the stern. The starboard and after bulkheads of the superstructure and deck houses are in general, slightly dished. This damage is intensified in the areas surrounding most weathertight doors which, together with their frames, are dished. Bulwarks of plating of 7# or less are generally damaged. The foremast bent forward and to port causing failure of the after starboard guys and of some antennae. Certain topside ladders are distorted.

MACHINERY

The stack, and the breeching between stack and uptakes, are dished and buckled, with numerous failures at riveted joints and several ruptures. The stack broke loose at its base on the starboard side, and is leaning to port. This motion of the stack caused buckling of the uptake breeching on the port side, below the joint between breeching and stack. The whistle and siren pulls are fouled.

ELECTRICAL

Not observed.

(c) Other damage.

HULL

No comment.

MACHINERY

Except for damage described under (b) above there is no damage to any part of the machinery installation. The vessel shifted berths under her own power after Test A, using speeds up to 10 knots. All machinery was operated at this time.

ELECTRICAL

There was no major electrical damage sustained by this vessel. The ship's service generators, emergency generator, and switchboards operated satisfactorily after the test. Minor electrical damage was sustained by:

1. Vent motor controller.
2. Running and anchor lights.
3. Lamps in main deck and superstructure spaces.
4. 36" searchlight.
5. Gyro repeater.
6. Announcing system reproducer.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

Radiation came from about 150 degrees relative at an elevation of about 5 degrees. Paint on exposed surfaces is badly blistered and scorched. Paint on wood is more badly damaged than paint on steel. Paint damage extends not more than about .002 inches under the surface. Exposed signal halyards and life lines are scorched. The only other equipment affected are lines which are weakened slightly by scorching.

MACHINERY

Paint on deck machinery was scorched and blistered.

ELECTRICAL

The paint on all topside cables in the way of the short duration the heat blast was charred. The electrical characteristics of these cables were not impaired.

(b) Fires and explosions.

HULL

Fire damage is insignificant. One small fire has occurred in a life raft, frame 140, starboard. Apparently direct heat radiation penetrated a torn section of the canvas covering and burned a small part of the wood floater ring.

MACHINERY

No evidence.

ELECTRICAL

None observed.

(c) Shock.

HULL

There is no evidence of shock damage.

MACHINERY

No evidence.

ELECTRICAL

There was no conclusive evidence that this vessel experienced any large degree of shock. Some of the broken light bulbs might be attributed to shock.

(d) Pressure.

HULL

The apparent direction of the pressure wave is from a point about 150 degrees relative. Damage to hull structure due to pressure is minor and is limited to slight dishing of the main deck aft, slight dishing of superstructure bulkheads, bending of the foremast, distortion of the stack, and dishing of doors in the weather bulkheads. Light non-structural sheet metal structures are generally dished and distorted. The critical weight of topside plating appears to be 10 pounds. No damage to heavier plating was observed.

MACHINERY

Blast pressure, apparently from near the starboard beam, caused the damage described under I (b) above. Whipping motion of the vessel following the blast pressure apparently caused motion of the journals of the low pressure turbine (indicated by leads left in the bearing during the test) up to a maximum of .009 inch.

ELECTRICAL

The only evidence of pressure effects noted on electrical equipment, was the shattering of the 36 inch searchlight lens, and about 20 percent of the installed lamp bulbs.

(e) Effects apparently peculiar to the atom bomb.

HULL

Aside from radioactivity, the general extent and intensity of heat radiation is the only peculiarity noted.

MACHINERY

Blast pressure of this magnitude at this range from the blast is apparently peculiar to the atomic bomb.

ELECTRICAL

There were many instances where hatches and doors were dished in and torn from their mountings by the extreme force of the blast, however, the electric light lamps within these same spaces were undamaged.

III. Effects of Damage.

(a) Effect on machinery, electrical, and ship control.

HULL

Not observed.

MACHINERY

Damage to the stack and uptake breeching reduces maximum boiler output somewhat (estimated at 10%). This reduces maximum speed of the ship by about 1 knot. The stack is greatly weakened and would have to be braced before the ship could steam in rough weather, or at high speed. High speed steaming is also impracticable with the ship in her present condition for the reason that stack gases escaping through the numerous openings near the main deck would be drawn into the ship's ventilation systems. It is estimated that temporary repairs could be made and temporary braces installed by the ship's force in approximately 2 days which would allow steaming at efficiency of 95% or higher for a limited time. It is estimated that approximately 6 days' work by a tender would be required to restore the stack and uptake breechings to normal.

Whistle and siren pulls could be cleared or new ones rigged by the ship's force within a short time.

ELECTRICAL

Damage to electrical equipment had no effect on the main electric plant or ship control.

(b) Effect on gunnery and fire control.

HULL

Damaged roller paths cause binding in train of the Mk 33 director and mounts.

MACHINERY

No comment.

ELECTRICAL

There was no effect on gunnery or fire control from electrical damage.

(c) Effect on water-tight integrity and stability.

HULL

None.

MACHINERY

No comment.

ELECTRICAL

Since there was no apparent failure of the below deck stuffing tubes, the watertight integrity of the vessel was not affected from an electrical viewpoint.

(d) Effect on personnel and habitability.

HULL

It is considered that topside personnel would have been badly injured by heat, blast, and radioactivity. Habitability has not been appreciably affected.

MACHINERY

It is not believed that there would have been any casualties among personnel below decks. Habitability is affected by the possibility of stack gases being drawn into the ship's ventilation systems. This would occur only if high speed were attempted. Otherwise, habitability was not affected by the test.

ELECTRICAL

There was no effect on habitability from electrical damage.

(e) Total effect on fighting efficiency.

HULL

The principal effects on the fighting efficiency of the ship are the injuries to personnel, the impairment of the director and mount 1, and the damage to antennae incident to the bending of the foremast. There is no impairment of strength or seaworthiness.

MACHINERY

The ship is limited to moderate speeds in good weather until after repairs to the stack and uptake breeching.

ELECTRICAL

There was no effect on the fighting efficiency of the vessel from electrical damage.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

This ship is not seriously damaged, however, the damage to antennae, the mast, the director and 5 inch mount 1 would prevent normal operation.

MACHINERY

The stack and the large flat, weak breechings between stack and uptakes, are obvious points of weakness against this form of attack. This fact is demonstrated also by the experience of the RHIND and HUGHES.

ELECTRICAL

The electrical damage on this vessel was confined to the main deck and above. This damage was so negligible that it had no effect on the habitability and fighting efficiency of the vessel.

V. Preliminary General or Specific Recommendations of Inspection Group.

HULL

Attention should be given to the elimination of pocketed areas in the superstructure. More adequate protection should be given to personnel in gunnery and ship control stations.

MACHINERY

Stacks should be made more resistant to blast pressure. A study should be made with a view to eliminating or greatly modifying the present type of uptake breeching, which is common to most of our recent destroyers.

ELECTRICAL

It is recommended that consideration be given to the elimination of the 36'' searchlight on this type vessel, since these searchlights are no longer used as originally intended, i.e. in conjunction with fire control. In the event these lights must be retained, it is considered that the design must be improved to withstand the excessive air blast. It is further recommended that exposed electrical equipment be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb.

TECHNICAL INSPECTION REPORT

SECTION I - HULL

GENERAL SUMMARY OF HULL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

There is no flooding and consequently no change in drafts or list.

(b) Structural damage.

There is slight dishing of the main deck between frames 147 and 179 with a permanent deflection of about 3/8 of an inch. This is accompanied by slight distortion of associated transverse and longitudinal girders and supporting stanchions. There is evidence of some increase during the test of previous damage to the shell plating on the starboard side and around the stern. The starboard and after bulkheads of the superstructure and deckhouses are in general, slightly dished. This damage is intensified in the areas surrounding most watertight doors which, together with their frames, are dished. Bulwarks of plating of 7# or less are generally damaged. The foremast bent forward and to port causing failure of the after starboard guys and of some antennae. Certain topside ladders are distorted.

(c) Other damage.

No comment.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Radiation came from about 150 degrees relative at an elevation of about 5 degrees. Paint on exposed surfaces is badly blistered and scorched. Paint on wood is more badly damaged

than paint on steel. Paint dan e extends not more than about .002 inches under the surface. Exp sed signal halyards and li e lines are scorched. The only other equipment affected are lines which are weakened slightly by scorching.

(b) Fires and explosions.

Fire damage is insignificant. One small fire has occurred in a life raft, frame 140, starboard. Apparently direct heat radiation penetrated a torn section of the canvas covering and burned a small part of the wood floater ring.

There were no explosions.

(c) Shock.

There is no evidence of shock damage.

(d) Pressure.

The apparent direction of the pressure wave is from a point about 150 degrees relative. Damage to hull structure due to pressure is minor and is limited to slight dishing of the main deck aft, slight dishing of superstructure bulkheads, bending of the foremast, distortion of the stack, and dishing of doors in the weather bulkheads. Light non-structural sheet metal structures are generally dished and distorted. The critical weight of topside plating appears to be in 10 pounds. No damage to heavier plating was observed.

(e) Effects apparently peculiar to the atom bomb.

Aside from radioactivity, the general extent and intensity of heat radiation is the only peculiarity noted.

III. Effects of Damage.

(a) Effect on machinery, electrical, and ship control.

Not observed.

(b) Effect on gunnery and fire control.

Damaged roller paths cause binding in train of the Mk 33 director and mounts.

(c) Effect on water-tight integrity and stability.

None.

(d) Effect on personnel and habitability.

It is considered that topside personnel would have been badly injured by heat, blast and radioactivity. Habitability has not been appreciably affected.

(e) Effect on fighting efficiency.

The principal effects on the fighting efficiency of the ship are the injuries to personnel, the impairment of the director and mount 1, and the damage to antennae incident to the bending of the foremast. There is no impairment of strength or seaworthiness.

IV. General Summary of Observers' Impressions and Conclusions.

This ship is not seriously damaged, however the damage to antennae, the mast, the director and 5 inch mount 1 would prevent normal operation.

V. Preliminary General or Specific Recommendations of Inspecting Group.

Attention should be given to the elimination of pocketed areas in the superstructure. More adequate protection should be given to personnel in gunnery and ship control stations.

VI. Loading Instructions to the Vessel Specified the Following:

ITEM	LOADING
Fuel Oil	Min.
Diesel Oil	Min.
Ammunition	10%
Potable and reserve feed water	95%
Salt water ballast	350 Tons

Details of the actual quantities of the various items aboard are included in Report 7, Stability Inspection Report, submitted by the ship's force in accordance with "Instructions to Target Vessels for Tests and Observations by Ship's Force" issued by the Director of Ships Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

(a) Minor damage has occurred to the hull in the flooding areas: main deck, frames 167-179, transom, and starboard shell, frames 70-90. It is difficult to determine the exact results of the blast as the hull had considerable operational damage before the test. The hull damage is in general an aggravation of the before test condition. It in no way jeopardizes either the strength or the operational characteristics of the ship. General views of the ship are shown in photos pages 47 to 62 .

(b) The most extensive damage has been to the superstructure where the foremast is bent, antennae are down, weather doors are dished and jammed, and flat metal surfaces such as weather bulkheads, and the stack and uptakes are dished. Several aluminum stiffeners have failed in way of tapped holes in the webs. Paint along the starboard side, and lifeline covers, snaking, and halyards have been scorched by the intense heat.

(c) The apparent causes of damage are the blast wave and heat of the explosion. The only evidence of possible shock damage is the damaged stable element electronic tubes in the 5" director. This damage, however, probably resulted from the blast. Light bulbs and other radio tubes are not damaged.

(d) There has been no appreciable flooding. There is leakage at the rate of one inch per day into D-312V, the after peak tank. Drafts and list did not change during the test. The residual strength and buoyancy are not appreciably affected. The stack mast have been so weakened that the ship would be in danger of losing both in a seaway. The damage to the superstructure prevents normal operation of the vessel.

B. Superstructure.

(a) Description of damage.

The damage to the superstructure is more serious than that to any other section of the ship. Most of the damage is to starboard and aft as the hypocenter bore about 150 degrees relative (Photo 1899-2; page 63). The light structure in this area shows varying degrees of failure. The heaviest damage is in the pilot house where the overhead, forward and after starboard diagonal bulkheads, and the after port diagonal bulkhead are dished as much as three inches. Rivets have sheared in the connections of the overhead longitudinals on each side of the centerline to the forward and after bulkheads. The longitudinals are not bent appreciably nor fractured. The worst dish occurs in the after starboard diagonal bulkhead. The rivets between the bulkheads and the deck and overhead bounding angles have parted for a distance of five feet. The combination of these two rivet failures allows the overhead to sag about two inches. On the starboard side above the main deck there is general dishing of weather bulkheads (photo 1815-2; page 64). For the most part, the dished panels are defined by deck edges and adjacent frames or are in way of doors in the bulkhead. There is a general dishing of weather doors. Several aluminum stiffeners have failed in way of holes drilled in the webs or flanges.

Both the stack and mast are distorted by the blast pressure. The stack is dished about 18 inches on the starboard quarter from base to top. In addition it is twisted and bent forward and to port.(Photos 1748-3, 2171-2, 1899-6; page 65, 66, and 67).

The starboard uptakes are dished about 15 inches up to the 01 level and about 6 inches from the 01 level to the fairing piece. (Photos 1815-5, 4, 3, 1899-4; pages 68, 69. 70, and 71). There are several ruptures in the uptakes, especially at corners. On the port side the uptakes are buckled, but the damage seems to have been done by the bending of the stack rather than by direct blast pressure (photos 1849-2, 2171-3; pages 72 and 73).

The horizontal riveted joint between the stack and fairing piece has failed for a length of about eight feet. The bottom of the stack has torn loose along the rivet holes leaving the rivets in the fairing piece in this area. Both the inner and outer casings are damaged. The after starboard guys of the foremast parted and the foremast is bent forward and to port about six degrees starting about 20 feet from the top where there is a reduction in size (Photos 2198-5, 6; pages 74, and 75). Most antennae are down. Whip antennae are badly bent but are generally operable.

There is a general failure of exposed sheet metal work such as flag bags, lockers, and sun shields on 20MM ready service boxes. Ladders have bent and have failed at their end connections (photo 1815-1; page 76). Bulwarks fabricated from 5 pound plate at 20 MM gun stations are dished.

The 36-inch searchlight was knocked off its trunnion seats and is resting on the trunnion plates. The lens is broken but the light is still operable.

An interesting phenomenon occurred at frame 65, main deck, where apparently the blast entered the starboard side and was guided across the ship through the athwartships passage to the port side where it turned aft. All doors in this area are dished. The inboard bulkhead of the wardroom pantry is demolished (Photos 1815-6, 1848-12; pages 77 and 78)., and the water-tight door is dished and twisted. Rivets between the bulkhead and lower bounding angle have failed as have many at the top of the bulkhead. The after bulkhead of the provision issue room has failed (photo 1849-1, page 79).

Pipe stanchions under the 20 MM gun foundation at frame 97, port, are bent. Numerous lifeline and pipe rail stanchions are bent.

(b) Causes of damage in each area.

Damage in all areas can be attributed to the high pressures on surfaces as a result of the blast.

(c) Evidences of fire in the superstructure.

There were no significant fires in any part of the superstructure. A small fire has occurred in a life raft at frame 140 (photo 1849-5; page 80). The wood in the supporting ring burned beneath a tear in the canvas cover. There is general scorching of paint, halyards, and serving on lines. (Photo 1848-11; page 81). Some of the serving had been covered with boot topping which was apparently considerably affected by the heat. Zinc chromate green seemed to burn as readily as regular Navy blue 5-n. The depth of scorching is about .002-inch. Scotch tape burned but the paint it covered did not.

(d) Estimate of relative effectiveness against heat and blast.

Plating under 10 pound weight is in general too light or insufficiently supported to resist damage.

(e) Constructive criticism of superstructure, design or construction including important fittings and equipment.

Casualties to those in the superstructure and around it would probably have been very high as a result of flash burns and injuries from the blast. Strengthening of all plating and structure and also further protection for those in exposed positions seems advisable.

C. Turrets, Guns and Directors.

Although damage to guns and directors is relatively minor, effective operation is limited. The after side of number 2 gun shield is dished approximately 4-inches, at the top of the chute for empty cases. Number 1 gun mount will train to port only 20 degrees.

The Mark 33 main battery director has a warped roller path which causes it to bind in train. The 5 pound protective plating is dished on after, forward and port sides. This plating was badly corroded before the test. All instruments in the director are intact except the stable element.

D. Torpedo Mounts, Depth Charge Gear.

There is no damage other than scorching of the starboard after depth charges, racks and projectors.

E. Weather Deck.

The main deck is slightly dished between frames 147 and 179. The scratch gages at in this area show a permanent, compression of about 3/8 of an inch. There is slight distortion of supporting stanchions and of transverse and longitudinal girders only between frames 167 and 179. The stanchions at frame 171, port and starboard, are bowed. The forecastle is dished about 1/8 of an inch. The extent of permanent distortion, such as dishing, prior to the test precludes any accurate description of damage caused by the test. Most damage is an aggravation of previous conditions. There is no further damage to the weather deck and its fittings, except scorching of paint. A tabulation of deck deflection scratch gage data is included as Appendix.

F. Exterior Hull.

The exterior hull, like the weather deck, was damaged prior to the test. The test has tended to increase the amount of existing damage. There is apparently additional dishing around the transom and on the starboard side between the following frames; 70-90. 125-128, and 180-183. Such damage is most readily observed from the interior of the vessel and will be discussed under G. Interior Compartments.

G. Interior Compartments (above w.l.).

(a) Damage to structure and causes.

The damge to the interior is principally an aggravation of the before test conditions. Some distortion of parts of the ship that were previously intact is a direct result of the test.

The following damage occurred to previously sound structure. The stanchions, port and starboard, between the main deck and first platform at frame 171 are buckled forward and inboard approximately one inch (photo 1898-9; page 82. The top and bottom welded connections of the stanchions remain intact. This damage is in way of a dish in the main deck. A scratch gage at frame 173, centerline, shows a deflection of 3/8 of an inch. Frame 171, starboard, is buckled in the web and the flange is distorted one foot above the second deck (photo 1898-11; page 83). The first platform starboard is bulged upward slightly at frames 167-169. The longitudinal bulkhead below the first platform is strained below the stanchion at frame 171. Fiberglass insulation under the main deck is knocked down over an area 4 feet by 6 feet, frames 174-179, midway between the centerline and port shell (photo 1899-1; page 84). The main deck longitudinals in this area apparently are not damaged.

The following conditions are aggravations of previously damaged structure.

(1) Frame 175, starboard, is severely buckled in the web between shell longitudinals just below the main deck bracket (photo 1898-10; page 85).

(2) Paint is cracked in webs at frames 29 and 33, starboard, between first platform and main deck.

(3) Port shell plating is dished at frame 36-1/2, about one foot above the first platform.

(4) Bulkhead 48, port, is severely buckled adjacent to shell from 30'' below main deck to 26'' above first platform. Shell plating is also dished in this area.

(5) Bulkhead 48, starboard is severely buckled adjacent to shell in way of a longitudinal two feet below the main deck.

(6) Frame 52, starboard, is severely buckled in the web, and the shell longitudinal just below the main deck bracket is distorted.

(7) Frames 56, starboard, is buckled in the web, and the shell longitudinal two feet below main deck is distorted.

(8) Frames 111 and 115, starboard, are buckled in the web, just above fire room grating.

(9) Frames 119 and 123, port, are slightly buckled.

(10) Frames 123 and 127, starboard, are severely buckled in web about six feet below the waterline.

(11) Bulkhead 131 adjacent to starboard shell is slightly distorted. A horizontal stiffener on the bulkhead is distorted and paint has been cracked.

(12) Frame 139, port, is severely buckled in the main deck bracket.

(13) Bulkhead 143, port is severely crumpled from main deck to about three feet above the first platform in way of an area of shell dishing.

(14) Frame 155, starboard, is severely buckled in the web about 28 inches below the main deck between shell longitudinals.

(15) Frame 159, port, has the web buckled about one foot above first platform.

(b) Damage other than structural.

Certain miscellaneous equipment inside compartments was damaged when located in way of structural damage. Such equipment includes built-in furniture, phones, and other small objects that were knocked to the deck. Otherwise there was no further damage in any of the compartments.

H. Armor Decks and Miscellaneous Armor.

Not Applicable.

I. Interior Compartments (below w.l.).

None observed.

J. Underwater Hull.

Packing around rudder port, has loosened permitting one inch per day leakage into D-312-V. There is no other apparent damage to the underwater hull.

K. Tanks.

No damage.

L. Flooding.

Except for leakage through the rudder stock gland into D-312-V, there has been no flooding.

M. Ventilation.

There is no apparent damage to ventilation in the interior of the ship. Most exterior ducts, however, are partially collapsed. The top six feet of the galley exhaust duct have been blown off.

N. Ship Control.

No damage.

O. Fire Control.

The bracket supports of the torpedo control panel on the port bridge wing have come loose (photo 1815-8; page 86). No other fire control damage noted except as discussed in Item C.

P. Ammunition Behavior.

Normal.

Q. Ammunition Handling.

No damage.

R. Strength.

There is no change in longitudinal strength.

TECHNICAL INSPECTION REPORT

SECTION II - MACHINERY

GENERAL SUMMARY OF MACHINERY DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

No data taken by machinery group.

(b) Structural damage: superstructure, hull, interior of hull, above and below armored deck (if fitted).

The stack, and the breeching between stack and uptakes, are distorted and buckled, with numerous failures at riveted joints and several ruptures. The stack broke loose at its base on the starboard side, and is leaning to port. This motion of the stack caused buckling of the uptake breeching on the port side, below the joint between breeching and stack. The whistle and siren pulls are fouled.

(c) Damage: machinery and ship control.

Except for damage described under (b) above there is no damage to any part of the machinery installation. The vessel shifted berths under her own power after Test A, using speeds up to 10 knots. All machinery was operated at this time.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Apparent direction (if any); extent longitudinally, transversely, penetration, significant behavior of structure or equipment.

Paint on deck machinery was scorched and blistered.

(b) Fires and Explosions.

Situation; nature of combustible or explosive; normal stowage; cause of ignition; extent and result.

No evidence.

(c) Shock.

Apparent direction (if any); areas affected; critical scantlings; nature of joint failures (general); effect on machinery and equipment; significant behavior of structure or equipment.

No evidence.

(d) Pressure.

Apparent direction (if any); areas affected; critical scantlings; general nature of failures; significant behavior of structure and equipment.

Blast pressure, apparently from near the starboard beam, caused the damage described under I (b) above. Whipping motion of the vessel following the blast pressure apparently caused motion of the journals of the low pressure turbine (indicated by leads left in the bearings during the test) up to a maximum of .009 inch.

(e) Any effects apparently peculiar to the Atom Bomb.

Blast pressure of this magnitude at this range from the blast is apparently peculiar to the Atom Bomb.

III. Effects of Damage.

(a) Effect on machinery and ship control.

Damage to the stack and uptake breeching reduces maximum boiler output somewhat (estimated at 10%). This reduces maximum speed of the ship by about 1 knot. The stack is greatly weakened and would have to be braced before the ship could steam in rough weather, or at high speed. High speed steaming is also impracticable with the ship in her present condition for the reason that stack gases escaping through the numerous openings near the

main deck would be drawn into the ship's ventilation systems. It is estimated that temporary repairs could be made and temporary braces installed by the ship's force in approximately 2 days which would allow steaming at efficiency of 95% or higher for a limited time. It is estimated that approximately 6 days' work by a tender would be required to restore the stack and uptake breechings to normal.

Whistle and siren pulls could be cleared or new ones rigged by the ship's force within a short time.

The test had no other effect on operation of the machinery, all of which has been operated since Test A.

(b) Effect on gunnery and fire control.

No comment.

(c) Effect on watertight integrity and stability.

No comment.

(d) Effect on personnel and habitability.

It is not believed that there would have been any casualties among personnel below decks. Habitability is affected by the possibility of stack gases being drawn into the ship's ventilation systems. This would occur only if high speed were attempted. Otherwise, habitability was not affected by the test.

(e) Total effect on fighting efficiency.

The ship is limited to moderate speeds in good weather until after repairs to the stack and uptake breeching.

IV. General Summary (Not over 6-8 lines) of observers' impressions and conclusions.

The stack and the large, flat, weak breechings between stack and uptakes, are obvious points of weakness against this form of

attack. This fact is demonstrated also by the experience of the RHIND and HUGHES.

V. Any Preliminary General or Specific Recommendations of the Inspecting Group.

Stacks should be made more resistant to blast pressure. A study should be made with a view to eliminating or greatly modifying the present type of uptake breeching, which is common to most of our recent destroyers.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall Condition.

The stack and breeching between stack and uptakes are dished and buckled, with numerous failures at riveted joints. The stack broke loose on the starboard side and is leaning over to port. The whistle and siren pulls are fouled. There is no other damage to any part of the machinery installation.

(b) Areas of major damage.

Stack and breeching between stack and uptakes.

(c) Primary cause of damage in each area of major damage.

Blast pressure.

(d) Effect of Target Test on overall operation of machinery plant.

Damage to the stack and uptake breechings reduces the maximum boiler output by possibly 10%, reducing the ship's maximum speed about 1 knot. The stack is greatly weakened and would have to be braced before the ship could steam in rough weather or at high speed. It is estimated that temporary repairs could be made by the ship's force within 2 days, and that permanent repairs could be made by a tender within 6 days. The ship could steam at moderate speed in good weather without repairs. Whistle and siren pulls could be cleared; or new ones rigged, by the ship's force within a short time. The test had no other effect on overall operation of machinery. After Test A this vessel shifted berths under her own power, using speeds up to 10 knots.

B. Boilers.

1. The boilers themselves and uptakes below the main deck level are undamaged. All boilers were steamed after the test. Hydrostatic tests indicate no change in the tightness of the boilers.

2. The stack and breeching between stack and uptakes (above main deck) are moderately damaged. The starboard surfaces of both stack and breeching are dished and distorted. The stack was pushed over and is leaning somewhat to port. It has a horizontal rupture about 8 feet long on the starboard side, near the base. Motion of the stack caused buckling of the uptake breeching just below its connection to the stack.

3. On the starboard side there are many failures in the CRS sheet of both inner and outer casings of the stack and the uptake breeching. There are several ruptures in the sheets and numerous failures at riveted joints, where the rivets pulled through. A particularly bad failure of this nature is at the joint between the stack and uptake breeching. (See stack and breeching photos 2171-2, 3, 4, 5, 6, 7, and 8, 1748-2 and 3; pages 66, 73, 87, 88, 89, 90, 91, 92, and 65.

4. All boilers can be steamed in the ship's present condition, but maximum boiler output is reduced somewhat (estimated at 10 %) by restriction of gas passages incident to distortion of stacks and uptakes and reduction of efficiency because of the numerous openings through which stack gases can escape near the main deck. The latter would prevent steaming at high speed except under favorable wind conditions because of stack gases being drawn into ventilation systems. The stack is in a precarious position and would have to be braced to enable the ship to steam in rough weather, or at high speed.

5. It is estimated that temporary repairs could be made and bracing installed by the ship's force in approximately 2 days, which would allow steaming at 95% or higher efficiency for a limited time. It is estimated that approximately 6 days work by a tender would be required to restore the stack and uptakes breeching to normal.

C. Blowers.

Undamaged. All forced draft blowers (4 steam, 2 electric) were operated at full load after Test A. Overspeed governors have been checked and operate satisfactorily.

D. Fuel Oil Equipment.

1. Undamaged.

2. All fuel oil equipment was given an operating test after Test A. Fuel oil equipment in #2 fireroom was operated satisfactorily while the ship was underway at 10 knots for 1-1/2 hours.

E. Boiler Feedwater Equipment.

1. Undamaged.

2. All boiler feedwater equipment was operated while the ship was underway at 10 knots for 1 - 1/2 hours.

F. Main Turbines.

1. Undamaged. The main engines were operated for 1 - 1/2 hours at 10 knots approximately 100 R.P.M. and no abnormalities were noted.

2. All main engines were trammed for movement before and after Test A and their relative positions proved unchanged.

3. Leads left in the bearings of the port low pressure turbine indicate considerable motion of the rotor during the test, but not enough to damage the turbine.

PORT L. P. TURBINE - FORWARD BEARING

Forward lead	Before Test A	After Test A	Difference
Port	.006	.006	.000
Top	.014	.008	.006
Stb'd	.007	.007	.000
After lead			
Port	.007	.007	.000
Top	.013	.007	.006
Stb'd	.007	.007	.000

PORT L. P. TURBINE - AFTER BEARING

Forward lead			
Port	.009	.008	.001
Top	.018	.009	.009
Stb'd	.009	.005	.004
After lead			
Port	.007	.007	.000
Top	.017	.010	.007
Stb'd	.008	.008	.000

G. Reduction Gears.

1. Undamaged.

2. The main reduction gears were checked while the ship was underwat at 10 knots.

H. Shafting and Bearings.

Undamaged. The shafting and bearings were checked while the ship was underway.

I. Lubrication System.

Undamaged. The entire lubrication system operated during 1 - 1/2 hours of main engine operation and no abnormalities were noted.

J. Condensers and Air Ejectors.

Undamaged. All condensing equipment operated while the ship was underway. Operation was normal.

K. Pumps.

Undamaged. All pumps operated satisfactorily in service after Test A except one cruising condensate pump, which was inoperable before the test. Its condition was not changed by the test.

L. Main Generators (Turbine and Gears).

Undamaged. Both turbo-generators have been operated supplying ships light and power after Test A.

M. Propellers.

Undamaged. Close inspection of propellers was impracticable, however, no operational abnormalities were noted at 100 R.P.M.

N. Distilling Plant.

Undamaged. The distilling plant has been in operation since Test A with no change in the capacity of the plant or of the quality of the distilled water noted.

O. Refrigerating Plant.

Undamaged. The refrigerating plant has been in operation since Test A. No abnormal conditions have been noted.

P. Winches, Windlasses, and Capstans.

Undamaged. All equipment has been in operation since Test A and found satisfactory.

Q. Steering Engine.

Undamaged. The steering engine has been tested, and operated while the ship was underway.

R. Elevators, Ammunition Hoists, etc.

Undamaged. All ammunition hoists have been operated since Test A.

S. Ventilation (Machinery).

Undamaged. All ventilation equipment has been in operation since Test A.

T. Air Compressors.

Undamaged. Both high and low pressure air compressors have been operated under service conditions after Test A.

U. Diesels (Generators and Boats).

Undamaged. The diesel generator was operated for 12 hours on ship's load after Test A. Operation was normal.

V. Piping.

Undamaged. All piping was subjected to operating pressures normal to its particular system after Test A.

W. Miscellaneous.

1. The machine shop equipment has been operated and proved undamaged.

2. The laundry equipment has been operated and proved undamaged.

3. The ice cream machine has been operated and proved undamaged.

4. The whistle and siren are undamaged but their pulls were fouled by blast pressure.

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

(a) Drafts, list, general areas of flooding, sources.

Not observed.

(b) Structural damage.

Not observed.

(c) Damage.

There was no major electrical damage sustained by this vessel. The ship's service generators, emergency generator, and switchboards operated satisfactorily after the test. Minor electrical damage was sustained by:

1. Vent motor controller.
2. Running and anchor lights.
3. Lamps in main deck and superstructure spares.
4. 36" searchlight.
5. Gyro repeater.
6. Announcing system reproducer.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The paint on all topside cables in the way of the short duration the heat blast was charred. The electrical characteristics of these cables were not impaired.

(b) Fires and explosions.

None observed.

(c) Shock.

There was no conclusive evidence that this vessel experienced any large degree of shock. Some of the broken electric light bulbs might be attributed to shock.

(d) Pressure.

The only evidence of pressure effects noted on electrical equipment, was the shattering of the 36 inch searchlight lens, and about 20 percent of the installed lamp bulbs.

(e) Any effects apparently peculiar to the atom bomb.

There were many instances where hatches and doors were dished in and torn from their mountings by the extreme force of the blast, however the electric light lamps within these same spaces were undamaged.

III. Effects of Damage.

(a) Effect on electrical equipment and ship control.

Damage to electrical equipment had no effect on the main electric plant or ship control.

(b) Effect on gunnery and fire control.

There was no effect on gunnery or fire control from electrical damage.

(c) Effect on water-tight integrity and stability.

Since there was no apparent failure of the below deck stuffing tubes, the water-tight integrity of the vessel was not affected from an electrical viewpoint.

(d) Effect on personnel and habitability.

There was no effect on habitability from electrical damage.

(e) Effect on fighting efficiency.

There was no effect on the fighting efficiency of the vessel from electrical damage.

IV. General Summary of Observers' Impressions and Conclusions.

The electrical damage on this vessel was confined to the main deck and above. This damage was so negligible that it had no effect on the habitability and fighting efficiency of the vessel.

V. Any Preliminary General or Specific Recommendations of the Inspecting Group.

It is recommended that consideration be given to the elimination of the 36" searchlight on this type vessel, since these searchlights are no longer used as originally intended, i.e. in conjunction with fire control. In the event these lights must be retained, it is considered that the design must be improved to withstand the excessive air blast. It is further recommended that exposed electrical equipment be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The overall condition of the electric plant on this vessel was good. All major electrical units were still operable after the test.

(b) Areas of major damage.

The electrical damage to this vessel occurred primarily on the main deck and the superstructure levels.

(c) Primary causes of damage in each area of major damage.

The blast effect of the above surface burst was the primary cause of electrical damage to this vessel.

(d) Effect of target test on overall operation of electric plant.

The overall electrical operability was only slightly reduced. Searchlights, navigational lights, minor topside electrical equipment were damaged, but the main electric plant and its vital parts were unaffected. Ship control, fire control, communication systems and all power generating units remained in the same condition of operability as before the test.

(e) Types of equipment most affected.

Searchlights and navigation lights were the types of equipment most affected by the above surface burst.

B. Electric Propulsion Rotating Equipment.

Not applicable.

C. Electric Propulsion Control Equipment.

Not applicable.

D. Ship's Service Generators.

No damage.

E. Emergency Generators.

No damage.

F. Switchboards and Distribution Panels.

No damage.

G. Wiring, Wiring Equipment and Wireways.

Although the paint on the cables exposed to the weather were charred by the heat of the blast, the electrical characteristics of the cable were not impaired.

Recommendations: In those weather-deck locations where it is necessary to expose cables, the cables should be adequately covered with paint to insure protection against the heat flash.

H. Transformers.

No damage.

I. Submarine Propelling Batteries.

Not applicable.

J. Portable Batteries.

No damage.

K. Motors, Motor Generator Sets and Motor Controllers.

Motors and controllers on the weather deck had their paint scorched, but in no case was the operation of the equipment impaired. A 10 horsepower Westinghouse Electric Company motor controller mounted in fan room C-101-1EA had its bakelite panel fractured due to bulkhead distortion. The controller was still operable.

One bracket fan was blown off its wooden foundation on the after bulkhead of the wardroom. If the fan had been mounted on a steel plate as is modern practice, it is doubtful that damage would have occurred.

Recommendations: It is recommended that motor controllers mounted on light bulkheads be supported in such a manner that slight bulkhead distortion will not damage the motor controller.

L. Lighting Equipment.

The range light was charred, and the glass globe was completely covered with a grayish black frosted skin. The 1 1/4" by 1 1/4" steel angle foundation for this light was fractured, but the fixture was still supported.

The starboard side light was badly damaged. The fore and aft reflector was blasted off, and the remainder of the light was badly charred and smashed.

Two out of three of the 40 watt fluorescent commercial type lighting fixtures and all incandescent lamps in the wardroom were completely shattered. This was caused by blast pressure entering the wardroom through the pantry window. The port-hole cover to the pantry had been blasted out.

Recommendations: It is recommended that the resistance to air blast of running and anchor lights and their mountings be improved.

M. Searchlights.

The 12 inch signaling searchlight mounted on the starboard side of the navigating bridge, and facing toward the blast, had the glass frosted a gray black color.

The Sperry 36 inch searchlight, Type 36-16, Contract No. 39382, had its barrels jumped out of one trunnion, and settled on top of the control box case. This left the light supported only by one bearing. The front glass was broken, and the paint on the back door and sides of the barrel was charred. The iris was distorted and off track. The mirror was intact and undamaged.

Recommendations:

(a) Recommended that the searchlight trunnion support be improved so it will not be affected by air blast.

(b) Consideration should be given to the elimination of the 36 inch searchlights, since it is no longer used as originally intended; i.e. in conjunction with fire control.

N. Degaussing Equipment.

No damage.

O. Gyro Compass Equipment.

The gyro repeater mounted in the pilot house, manufactured by the Submarine Signal Company, Type C-1322360, was blasted free of its rubber vibration mounts. The unit was left supported only by the connecting electric cable. It is believed the vibration mount failed because too small a retainer washer was used to hold the unit in the rubber vibration mount.

P. Sound Powered Telephones.

No damage.

Q. Ship's Service Telephones.

Not applicable.

R. Announcing Systems.

A 1MC reproducer on the 02 deck level, port side, was broken from its base. Although completely severed from its connection box, the speaker was still operable. It was a Class M, Model MI-2915A reproducer manufactured by RCA.

Recommendations: Announcing system reproducers installed on the weatherdeck are extremely vulnerable to the air blast. It is recommended that the reproducers be recessed or preferably faired into the superstructure.

S. Telephones.

No damage.

T. Indicating Systems.

No damage.

U. I.C. and A.C.O. Switchboards.

No damage.

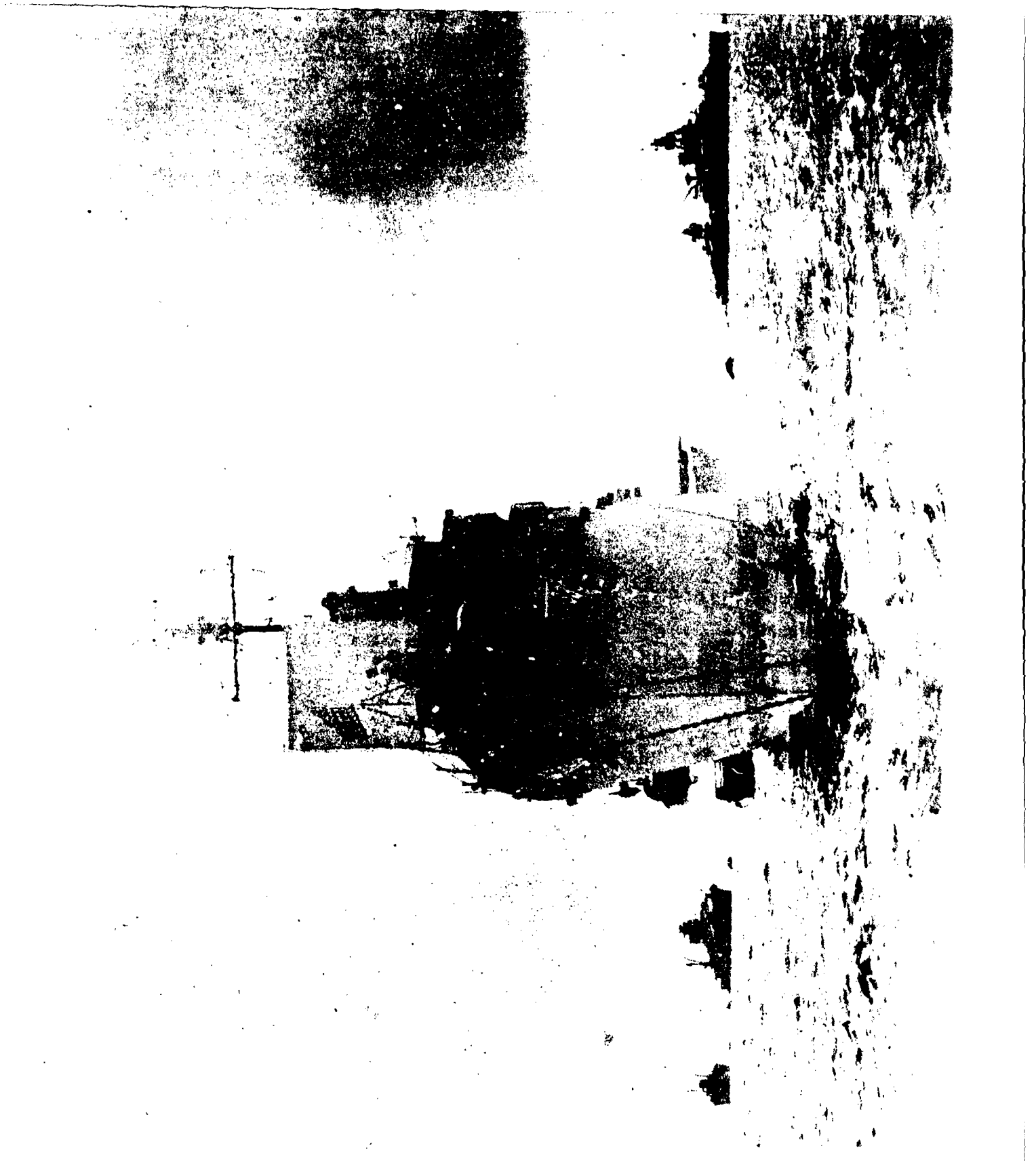
V. F.C. Switchboards.

No damage.

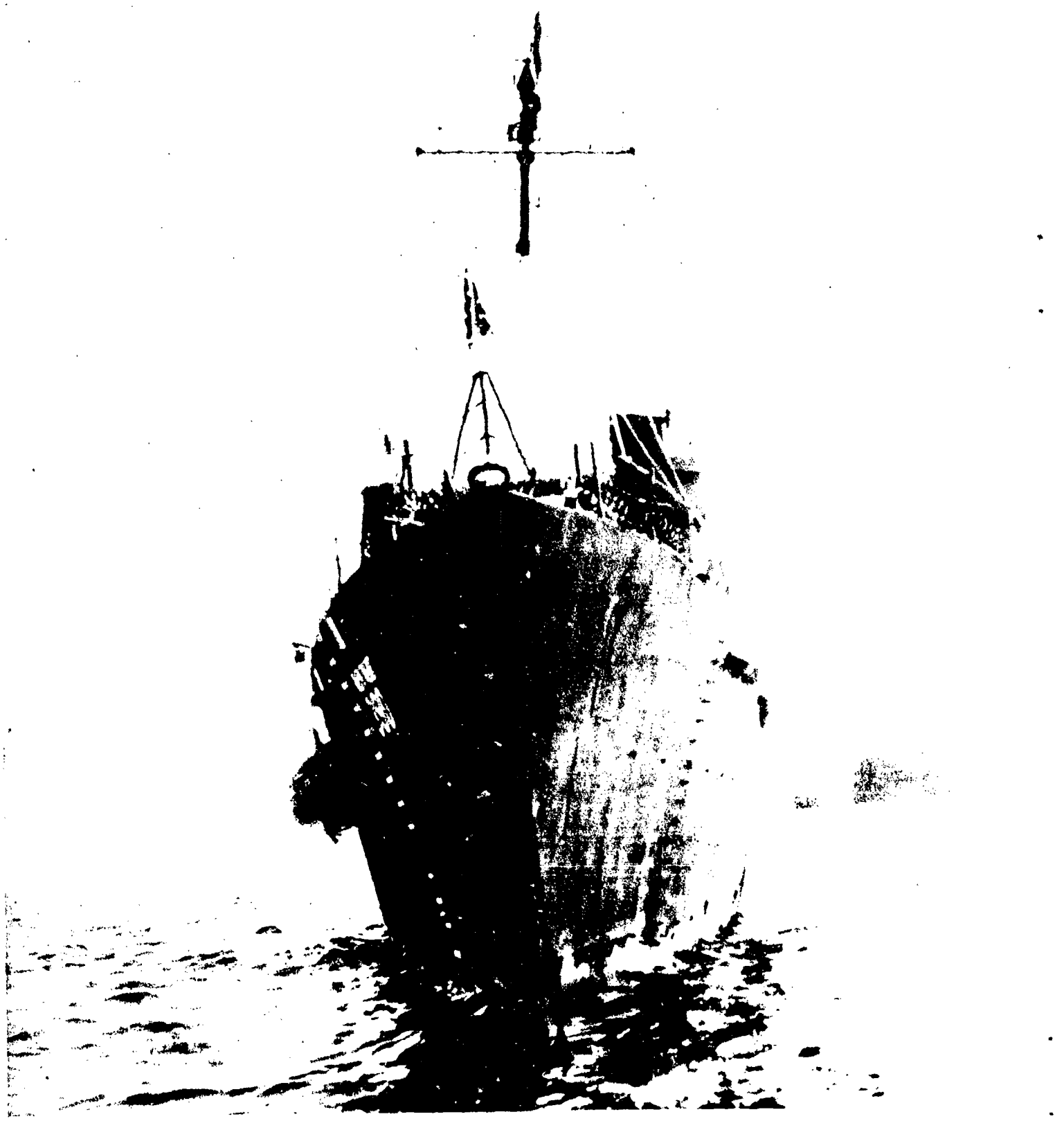
SECTION IV

PHOTOGRAPHS

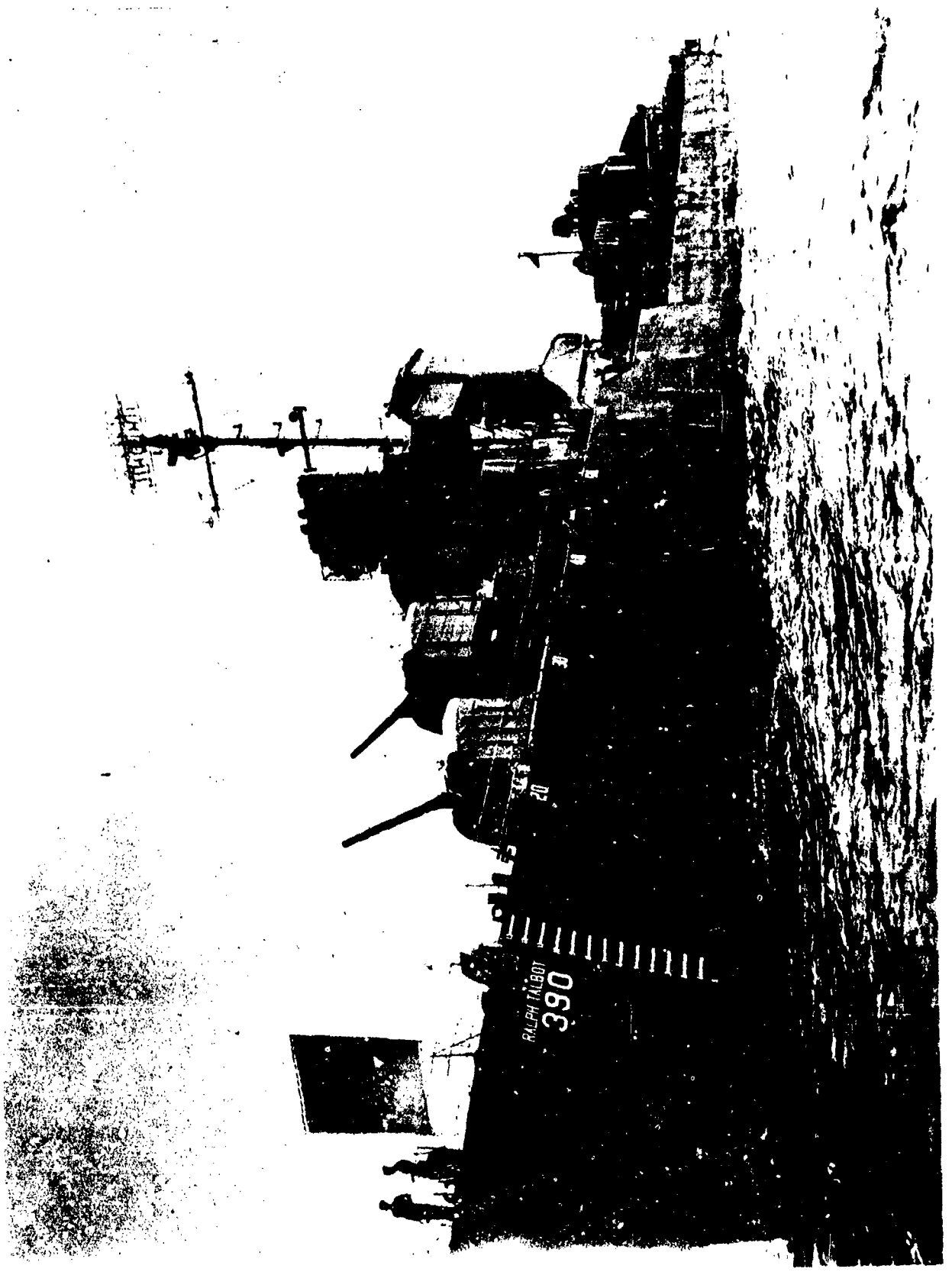
TEST ABLE



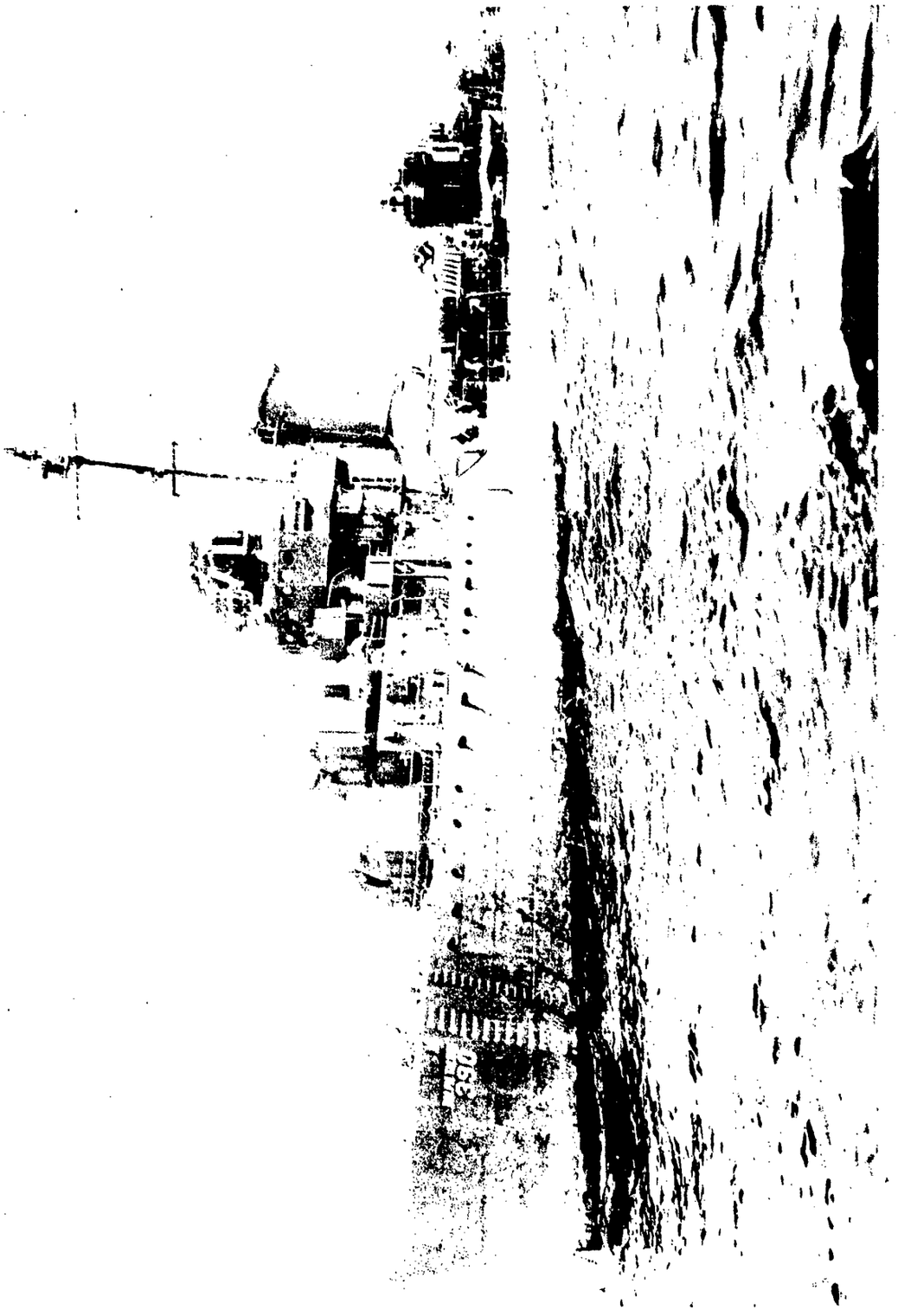
BA-CR-196-163-15. Bow before Test A.



AA-CR-227-50-45. Bow after Test A.

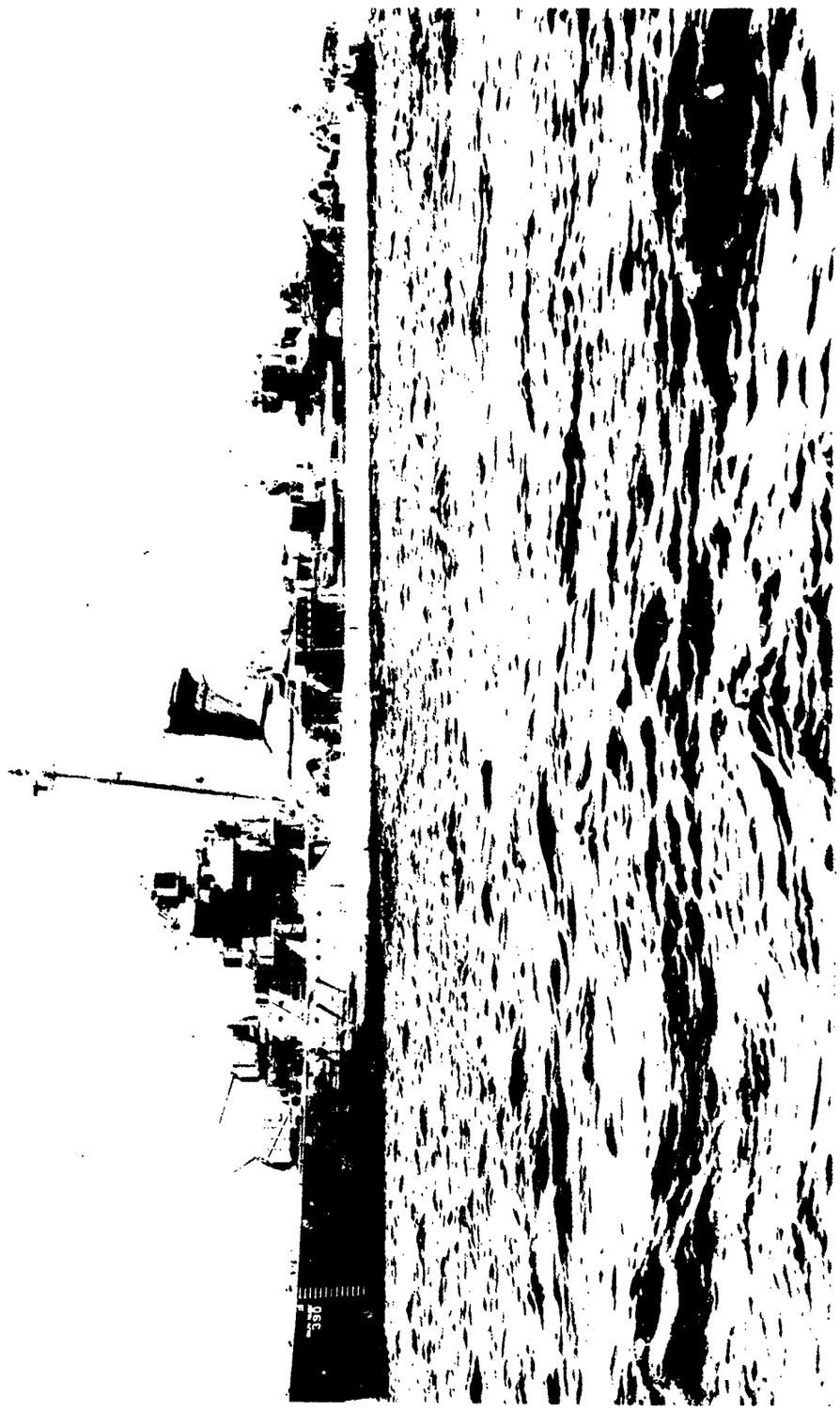


BA-CR-196-163-16. Port bow before Test A.

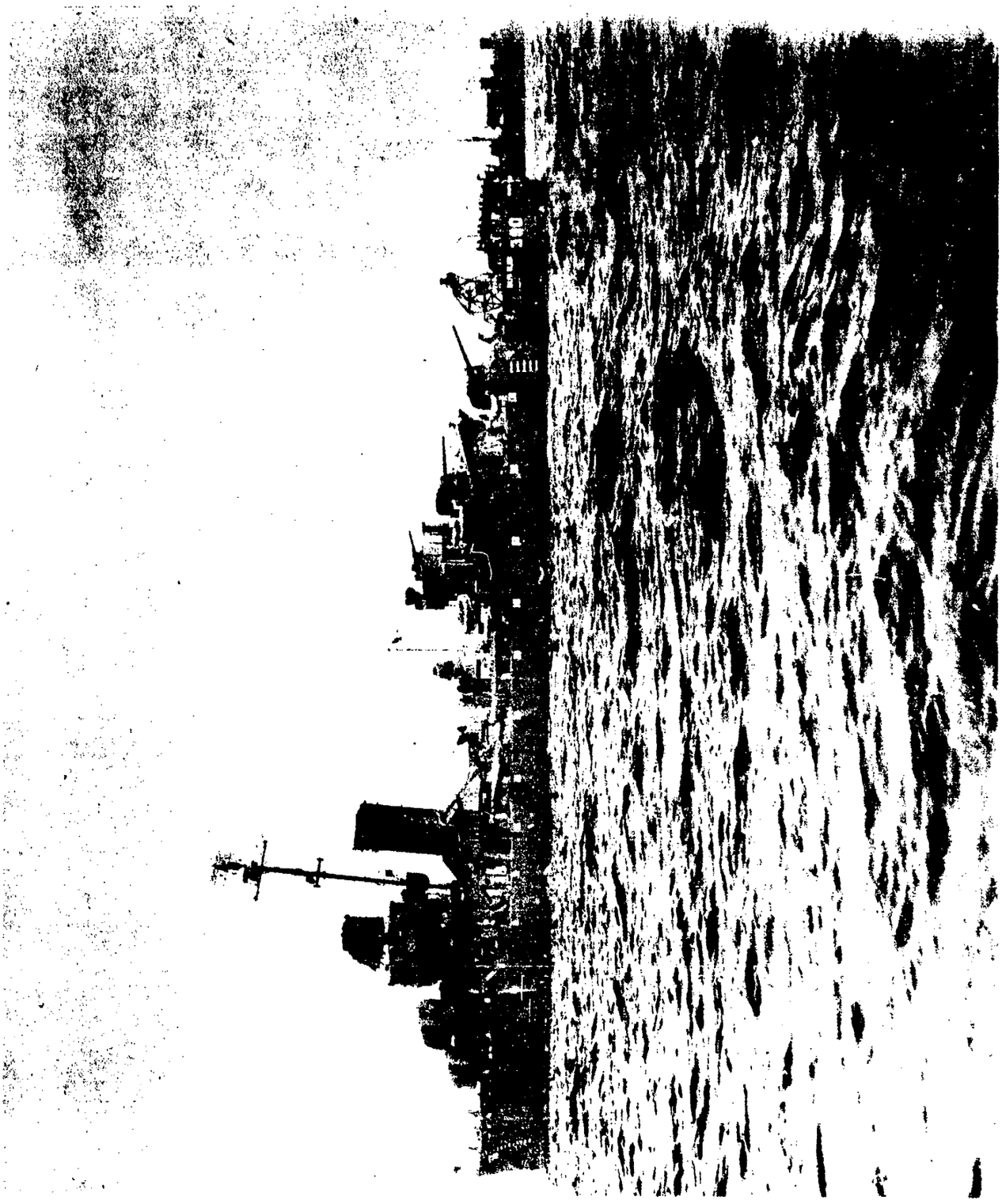


AA-CR-227-50-38. Port bow after Test A.

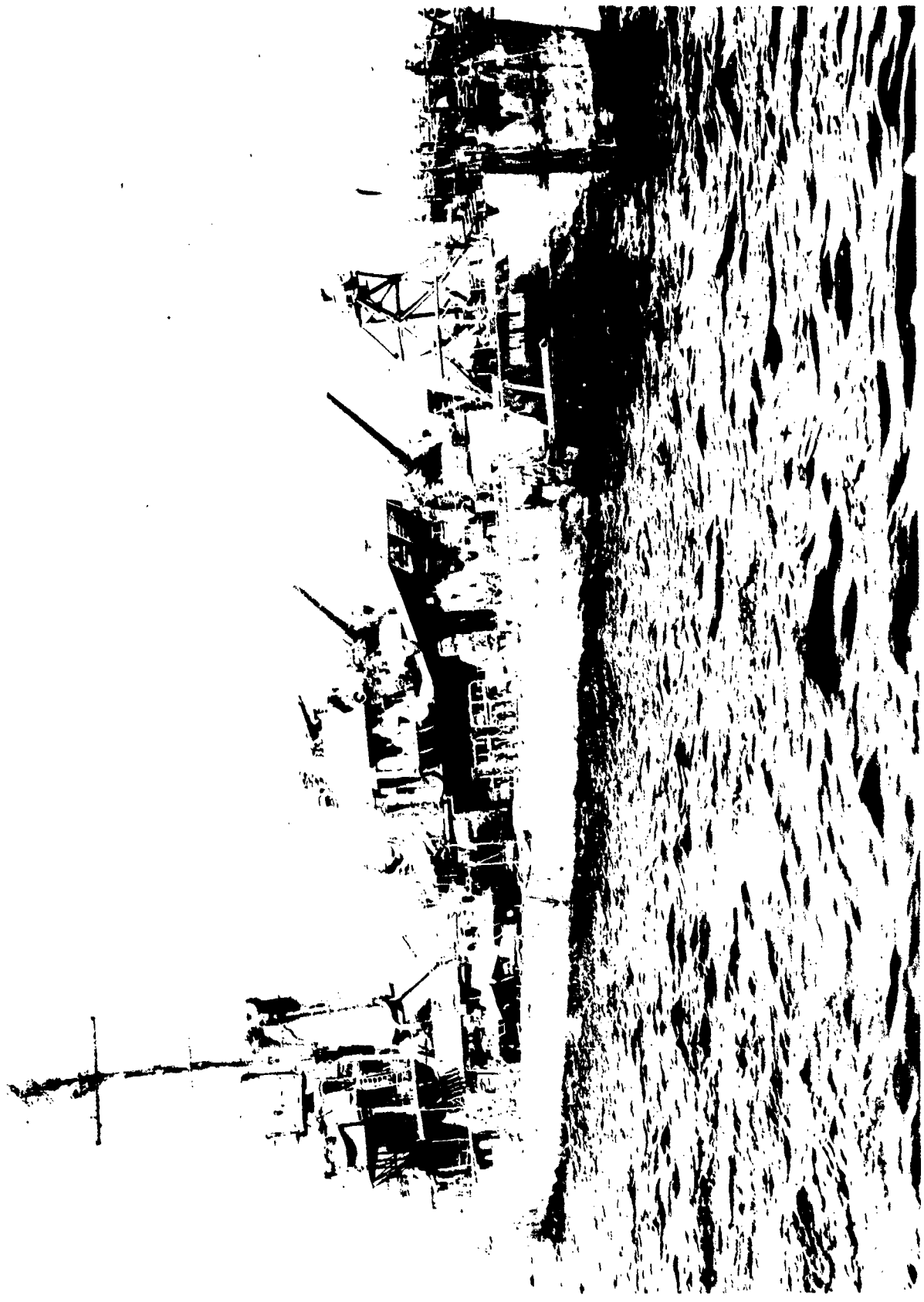
BA-CR-196-163-9. Port beam before Test A.



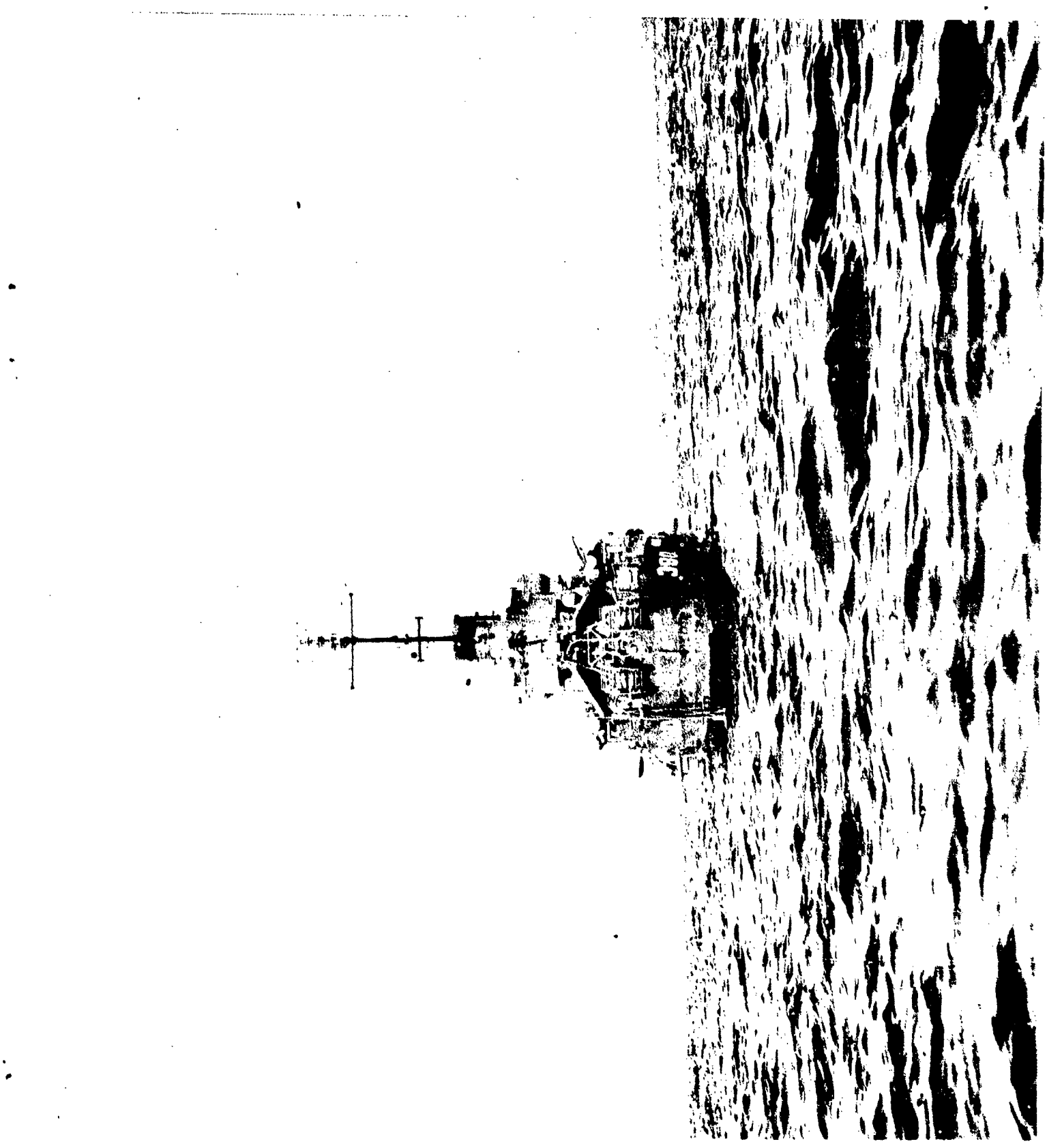
AA-CR-227-50-39. Port beam after Test A.



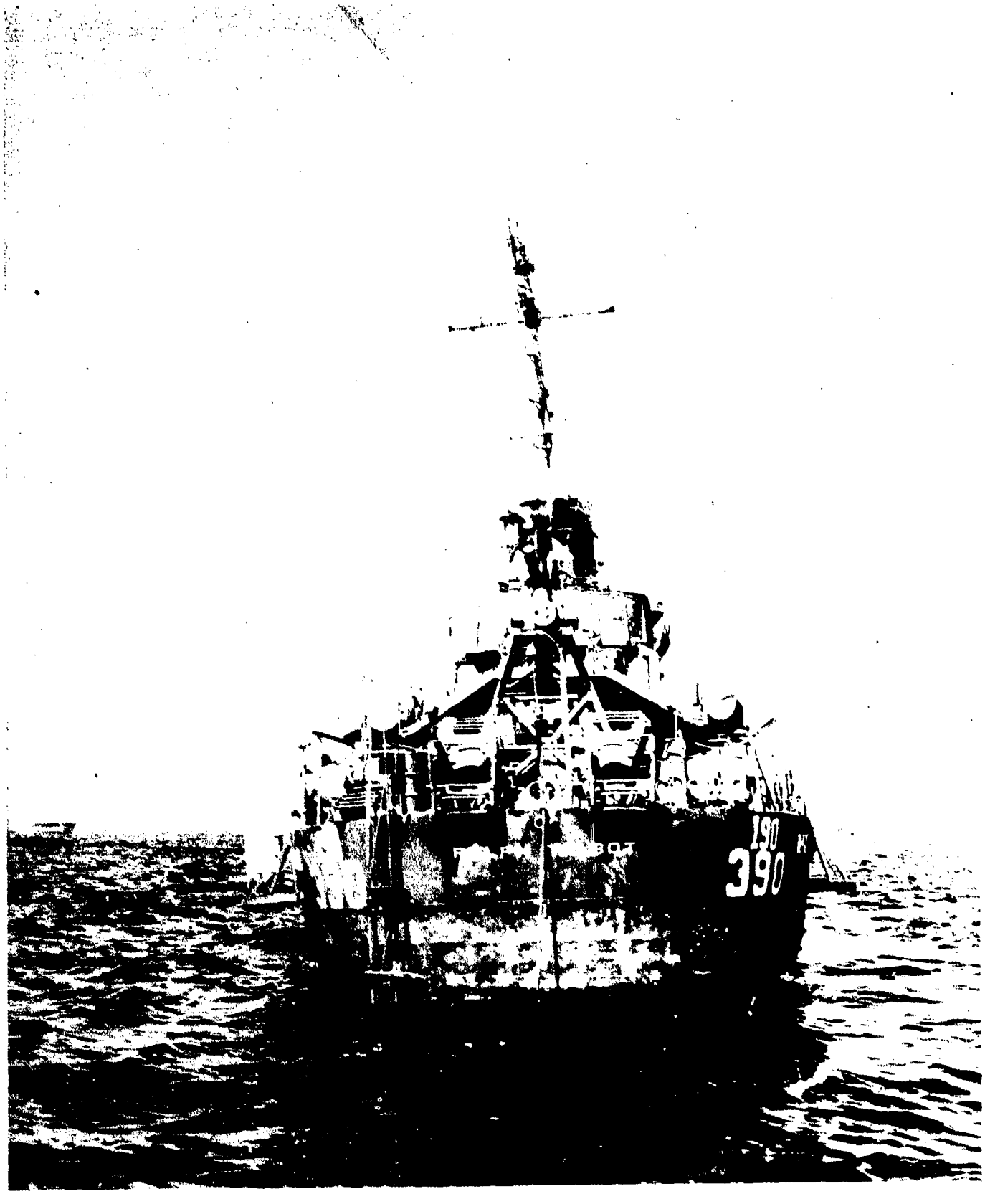
BA-CR-196-163-10. Port quarter before Test A.



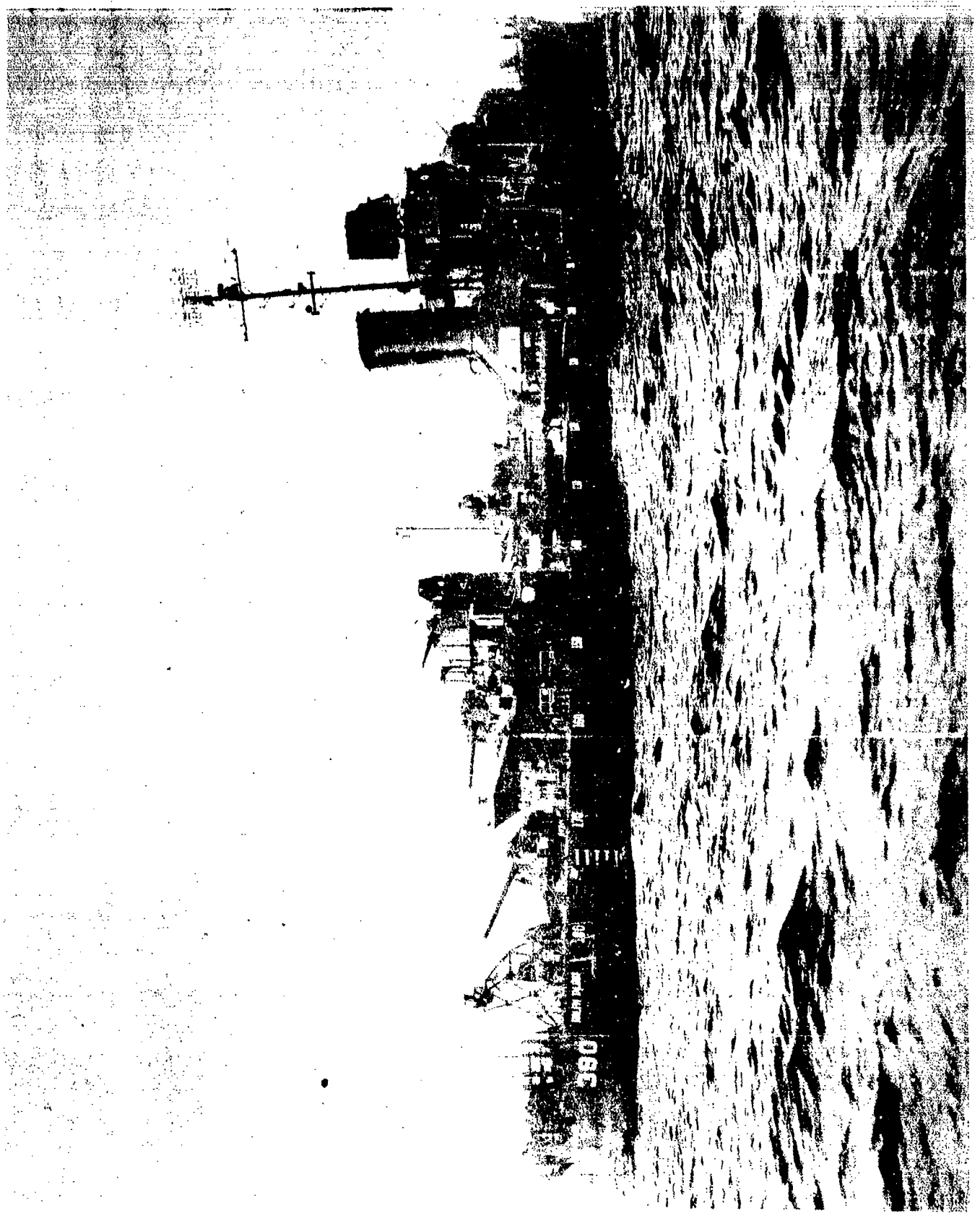
AA-CR-227-50-40. Port quarter after Test A.



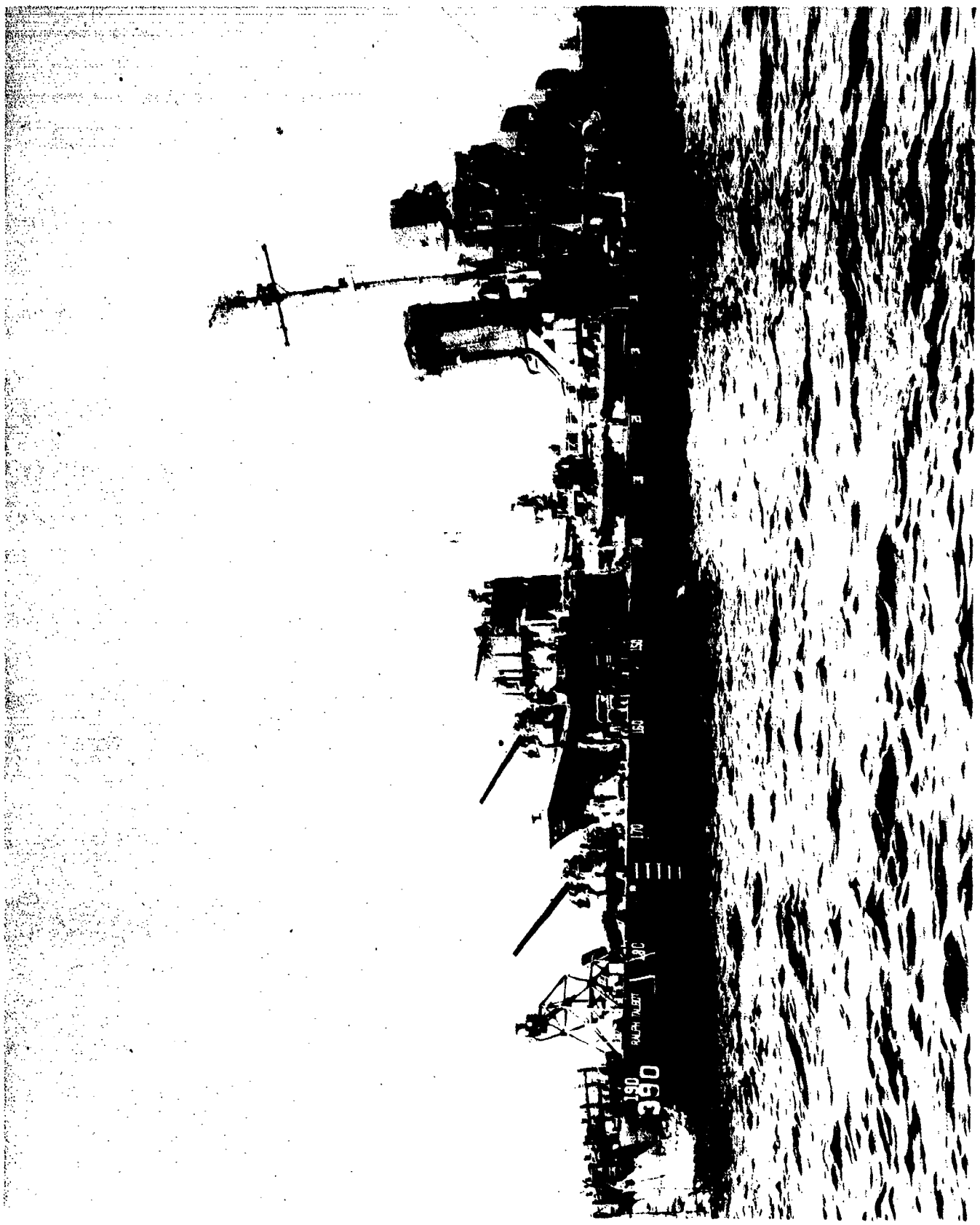
BA-CR-196-163-11. Stern before Test A.



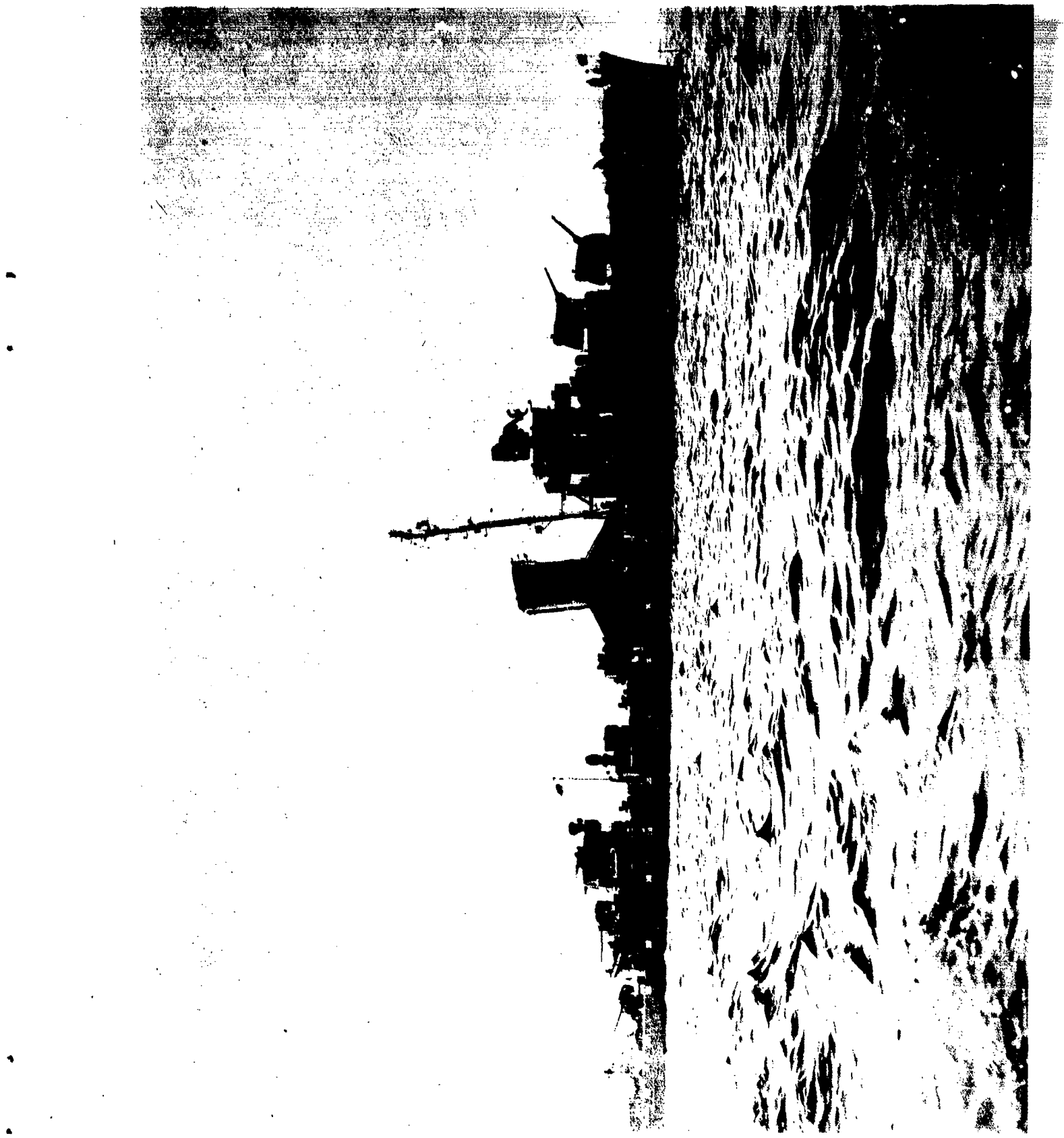
AA-CR-227-50-41. Stern after Test A.



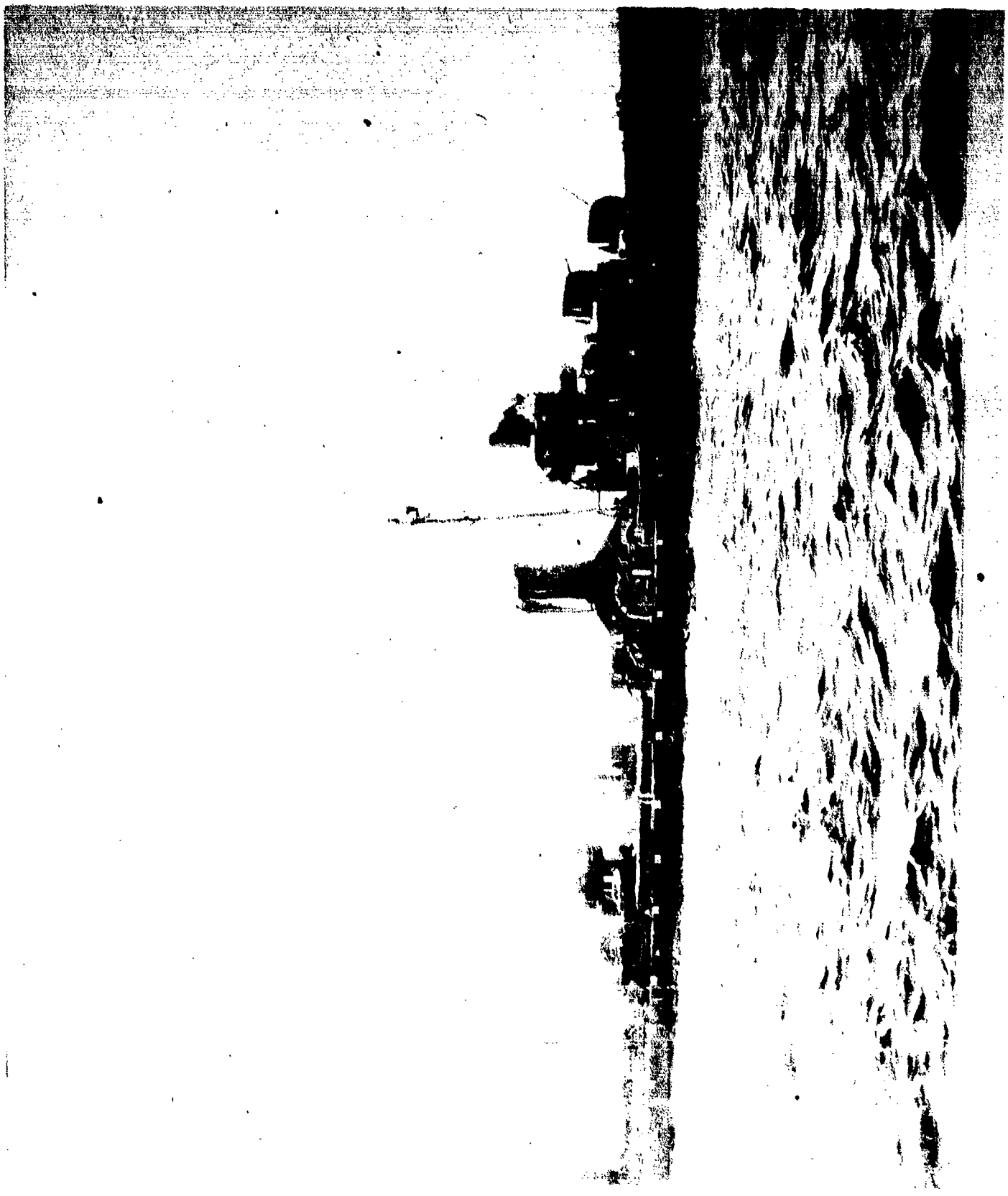
BA-CR-196-163-12. Starboard quarter before Test A.



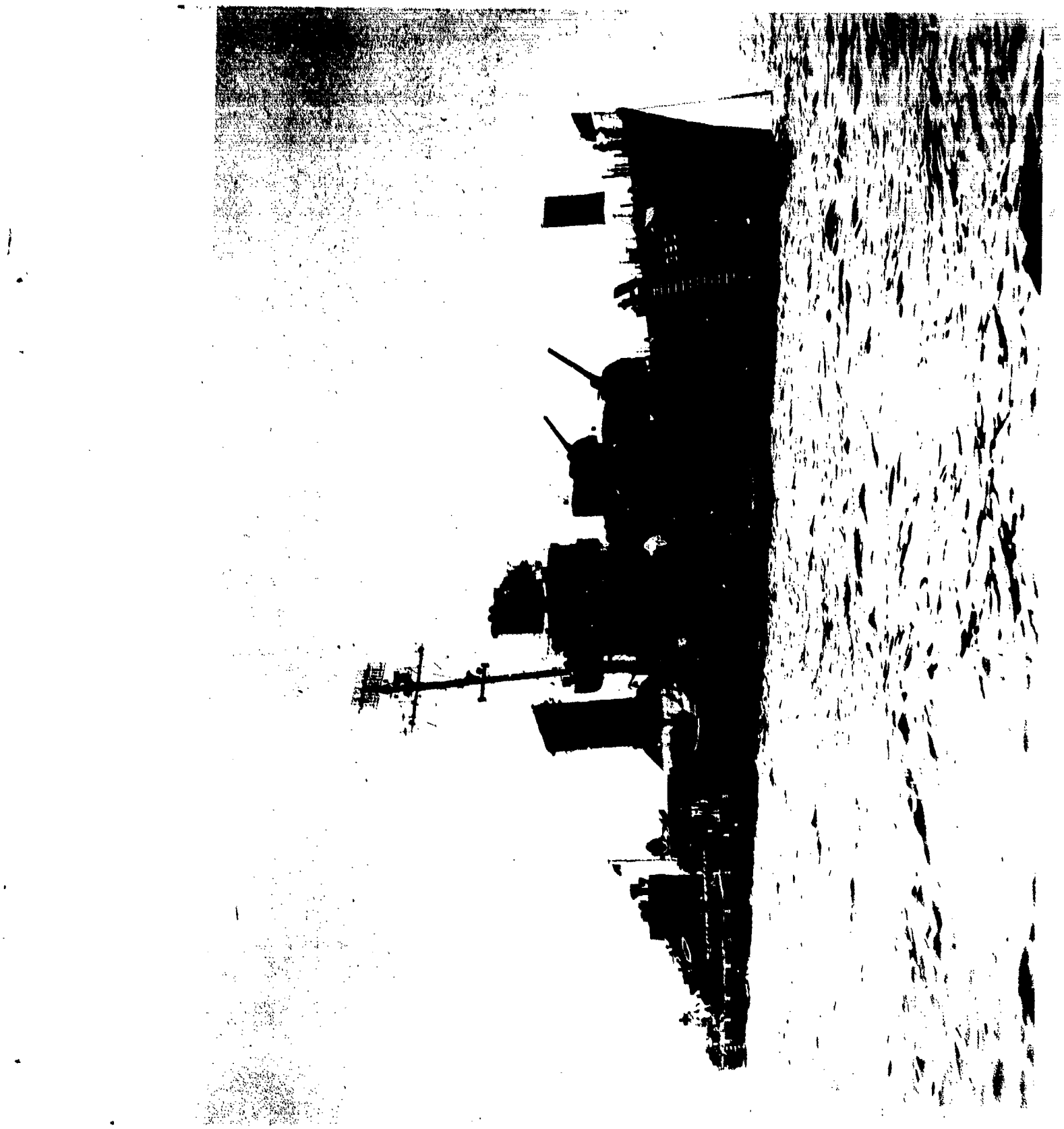
AA-CR-227-50-42. Starboard quarter after Test A.



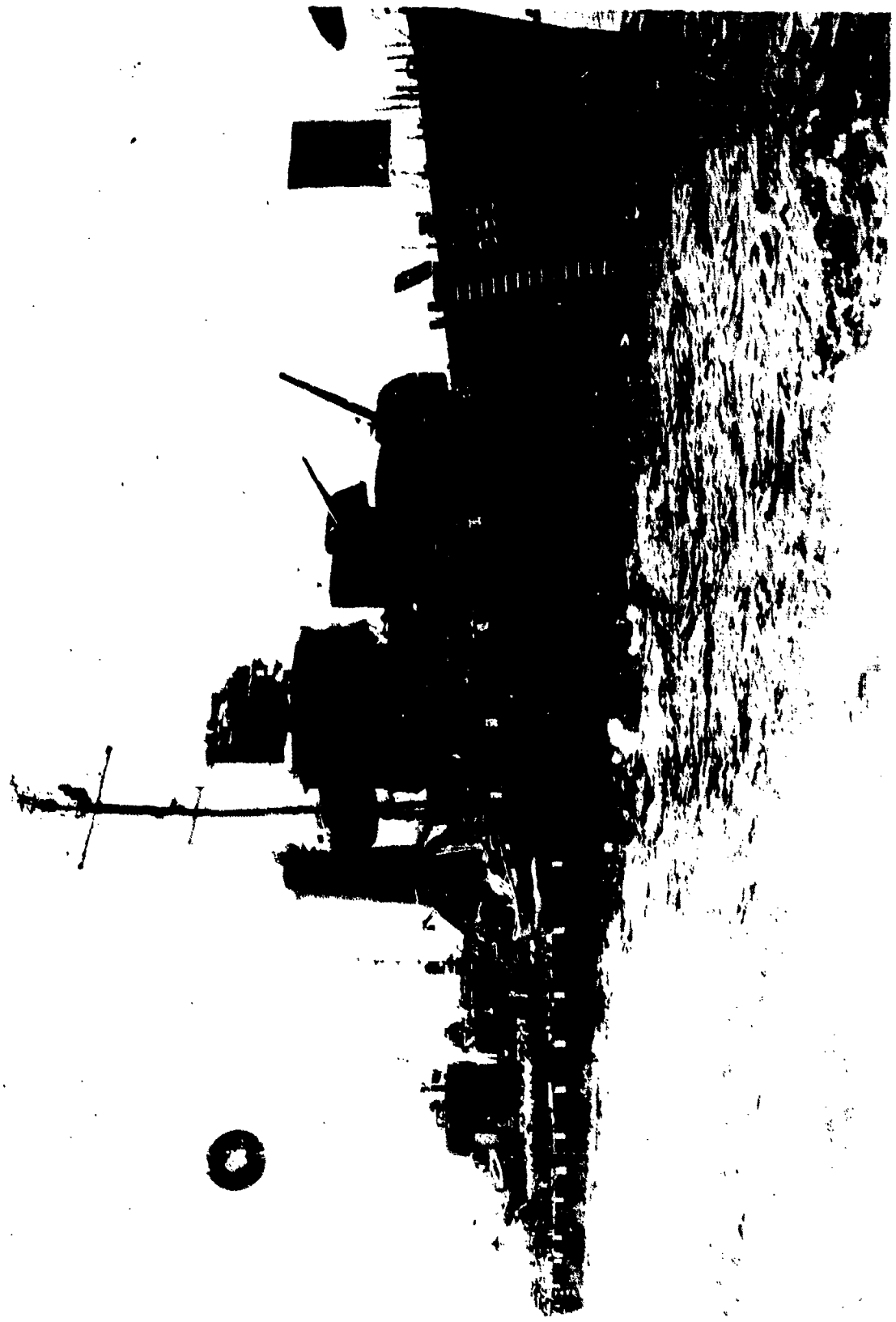
BA-CR-196-163-13. Starboard beam before Test A.



AA-CR-227-50-43. Starboard beam after Test A.



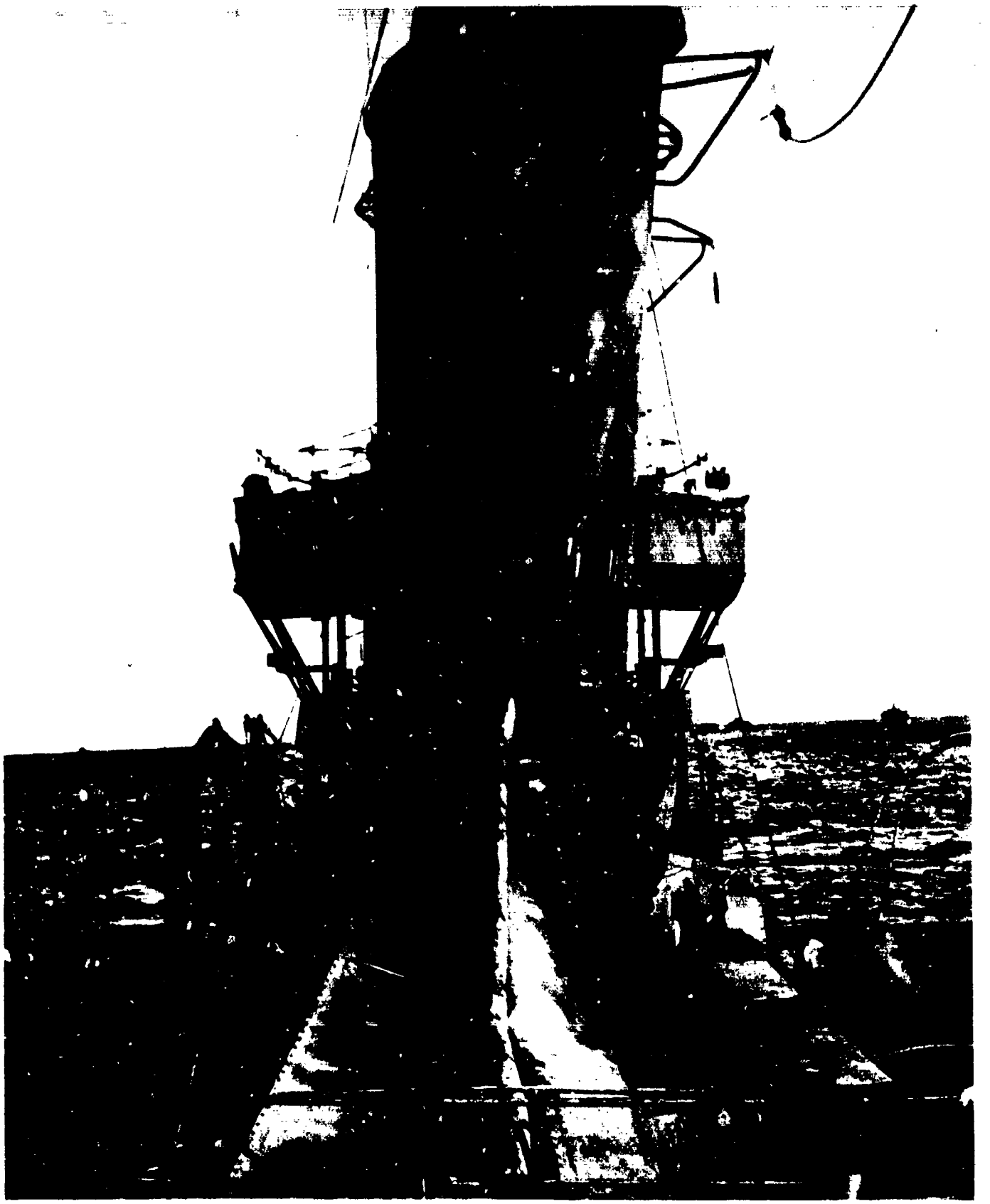
BA-CR-196-163-14. Starboard bow before Test A.



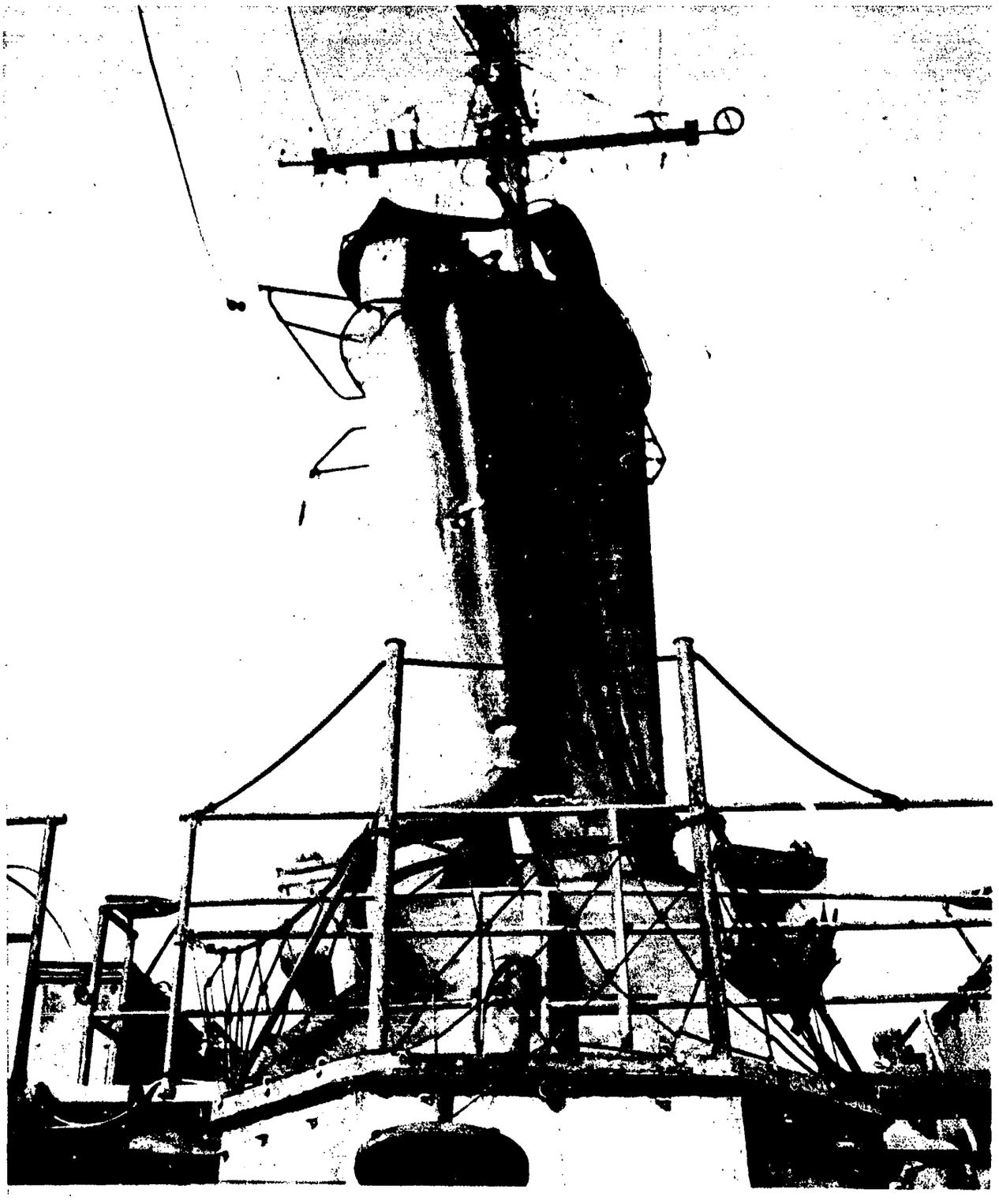
AA-CR-227-50-44. Starboard bow after Test A.

AA-CR-80-1899-2. Damage to after side of forward superstructure. Looking forward from starboard side.

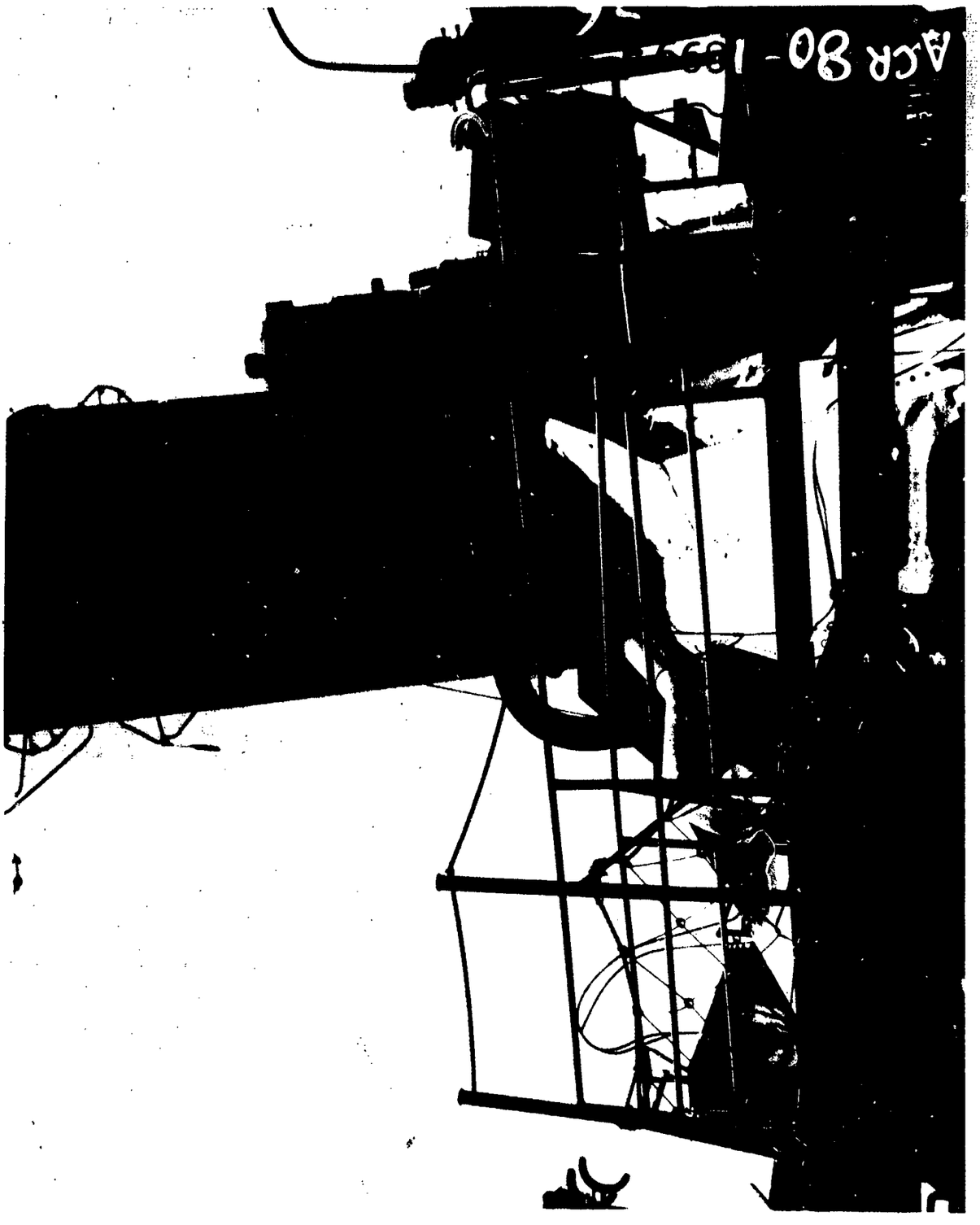
AA-CR-79-1815-2. Dished bulkhead and door to torpedo workshop. Main deck, frame 120, starboard.



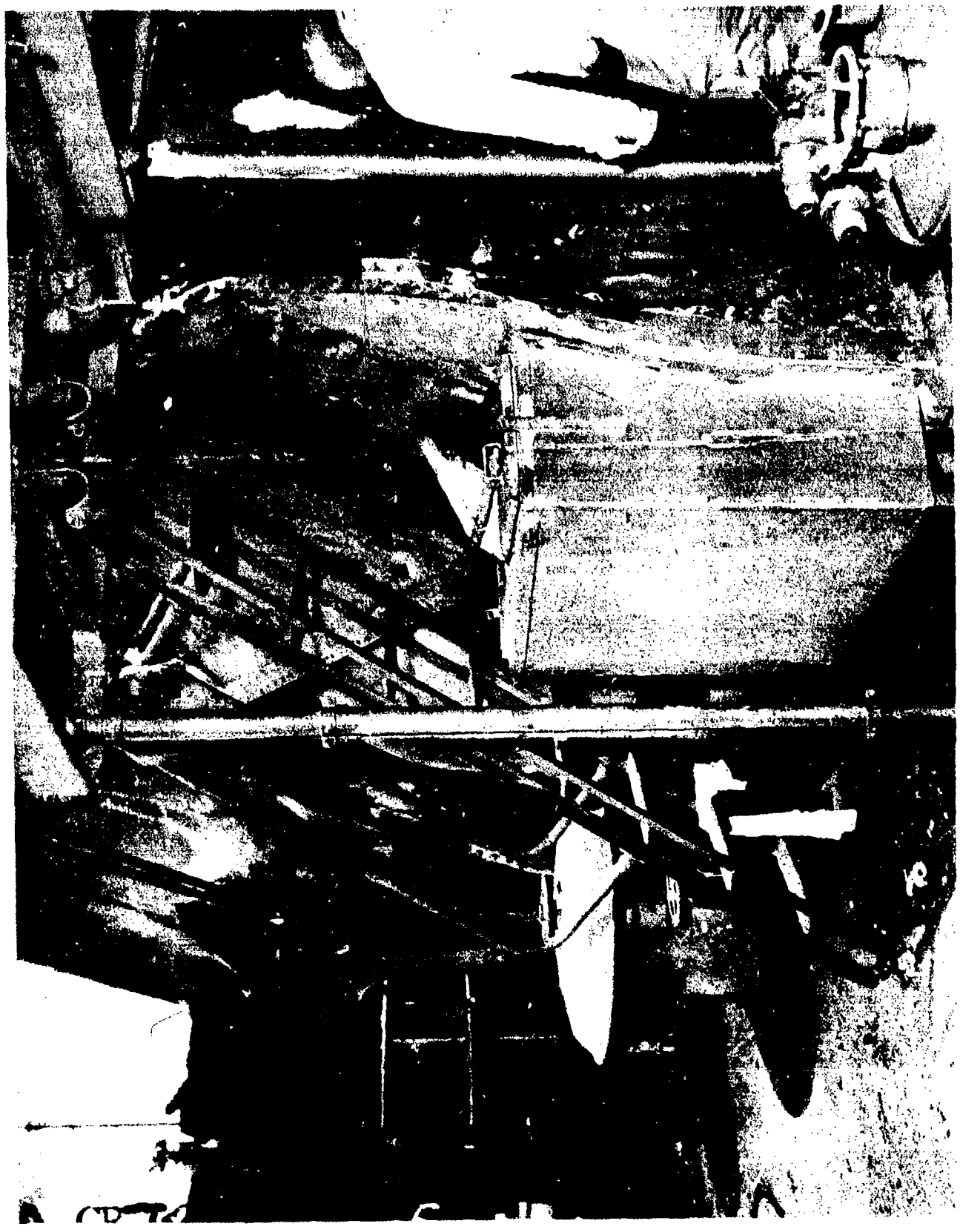
AA-CR-68-1748-3. Looking forward from searchlight platform toward damaged stack and uptakes.



AA-CR-62-2171-2. Looking forward at blast damage to stack.



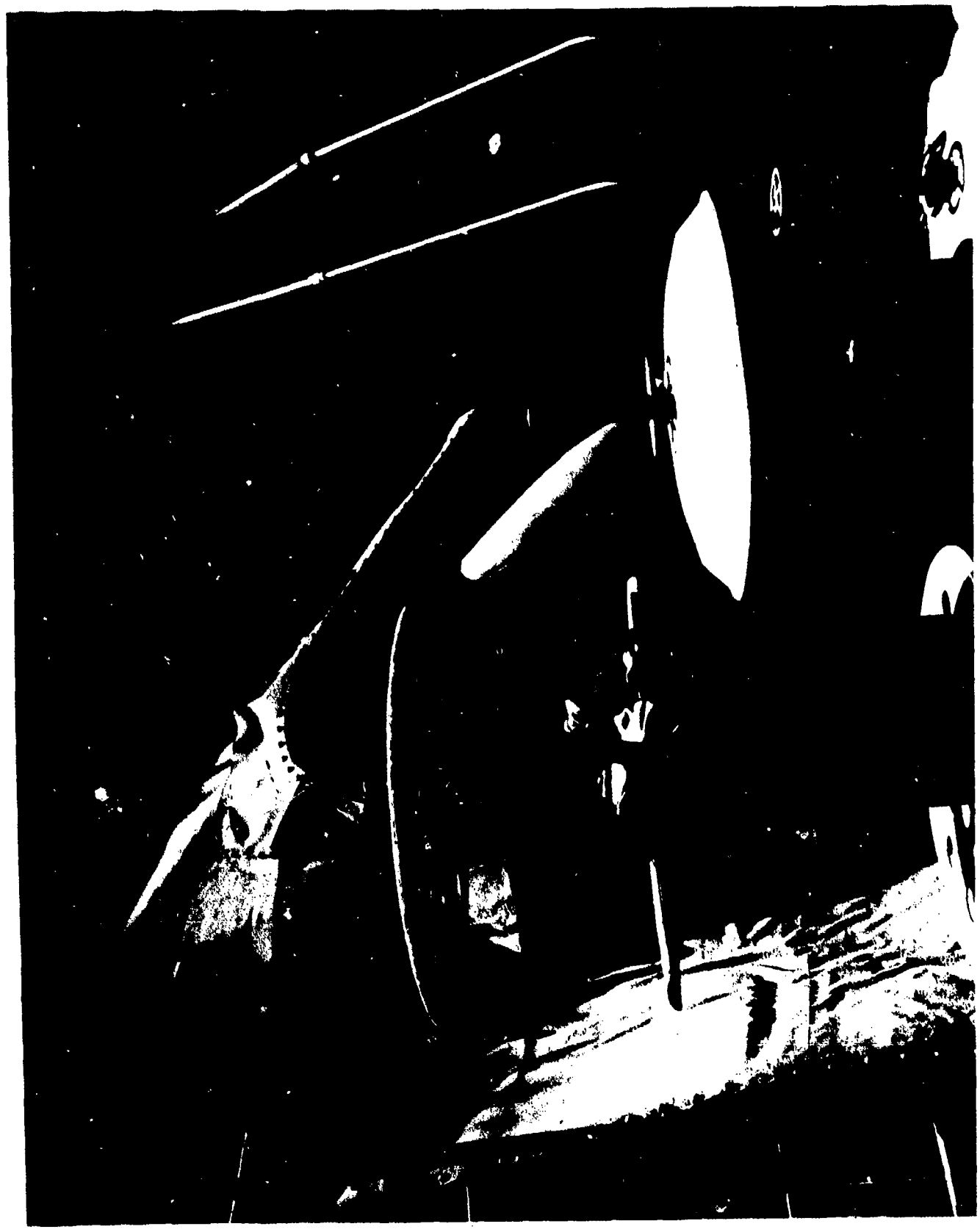
AA-CR-80-1899-6. Looking forward at blast damage to stack and uptakes. .



AA-CR-79-1815-5. Looking aft at blast damage to starboard uptakes.

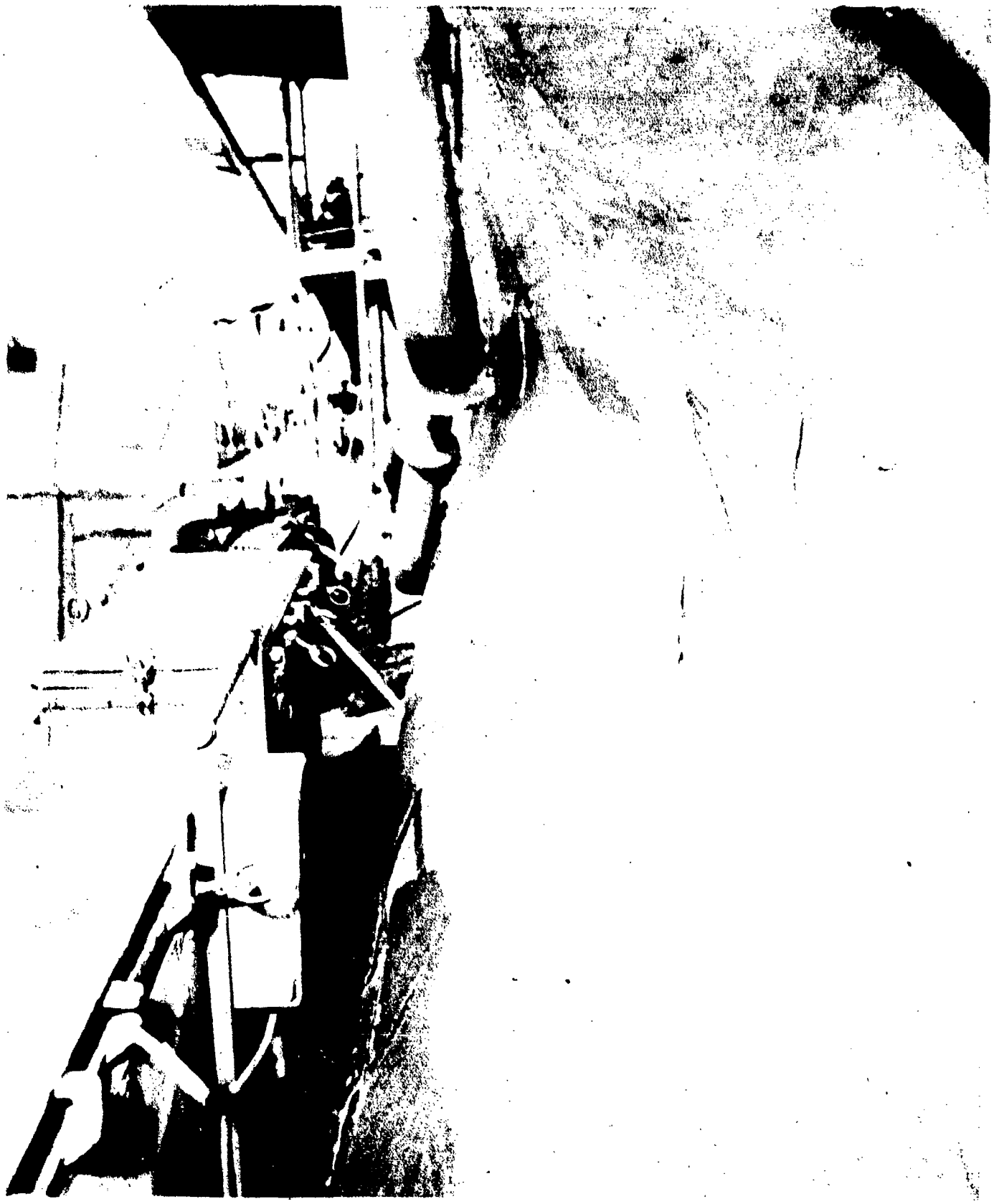
AA-CR-79-1815-4. Damaged uptake at frame 92, starboard.

AA-CR-79-1815-3. Damaged uptake at frame 102, starboard.



AA-CR-80-1899-4. Starboard uptakes showing damaged outer casing.

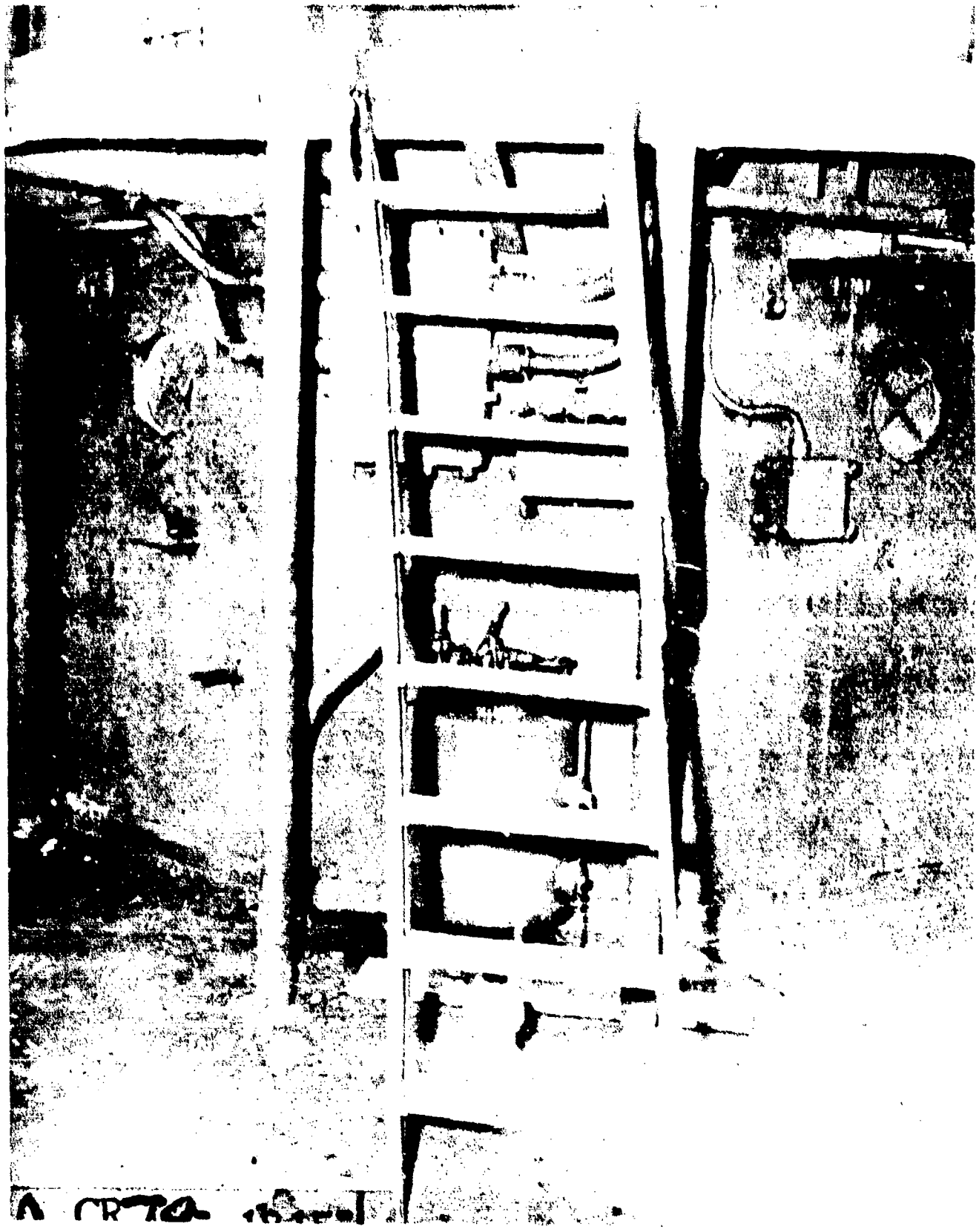
AA-CR-62-1849-2. Looking aft at damage to port uptakes.



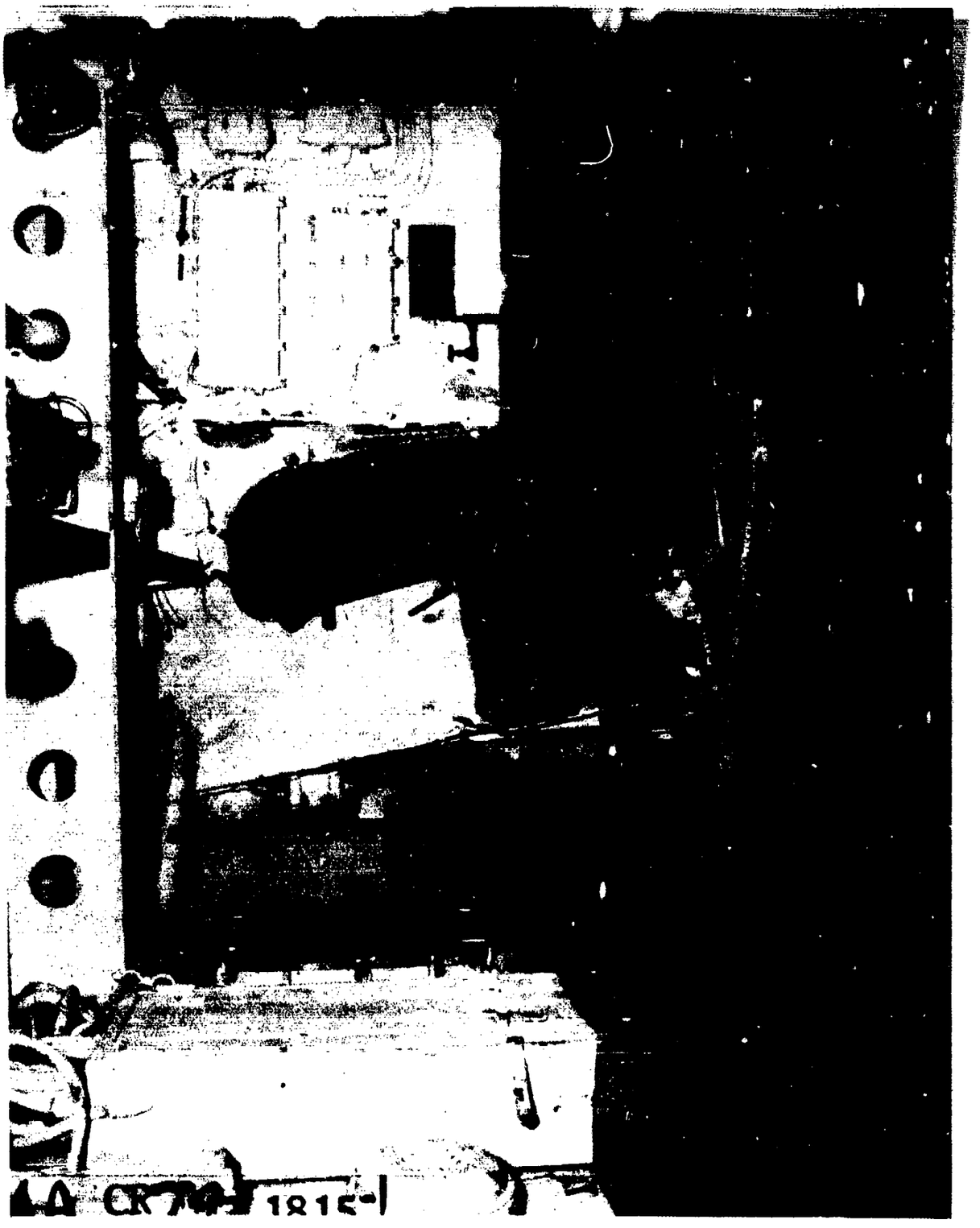
AA-CR-62-2171-3. Looking forward at damage to port uptake.

AA-CR-100-2198-5. Looking forward and to starboard at bent foremast.

AA-CR-100-2198-6. Looking to starboard at damaged foremast.



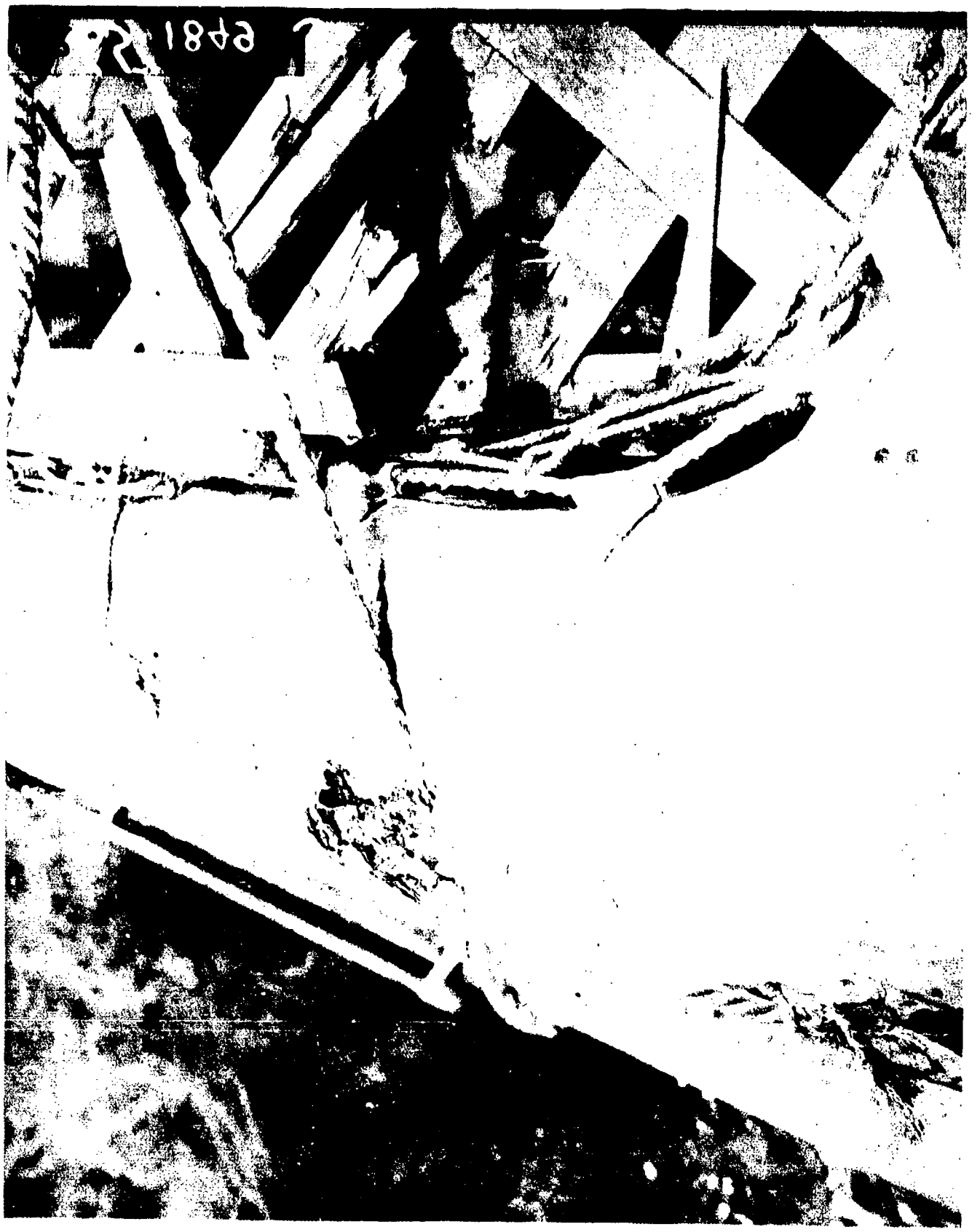
AA-CR-79-1815-1. View of bent amidship ladder leading to top of after deck house, frame 130, centerline.



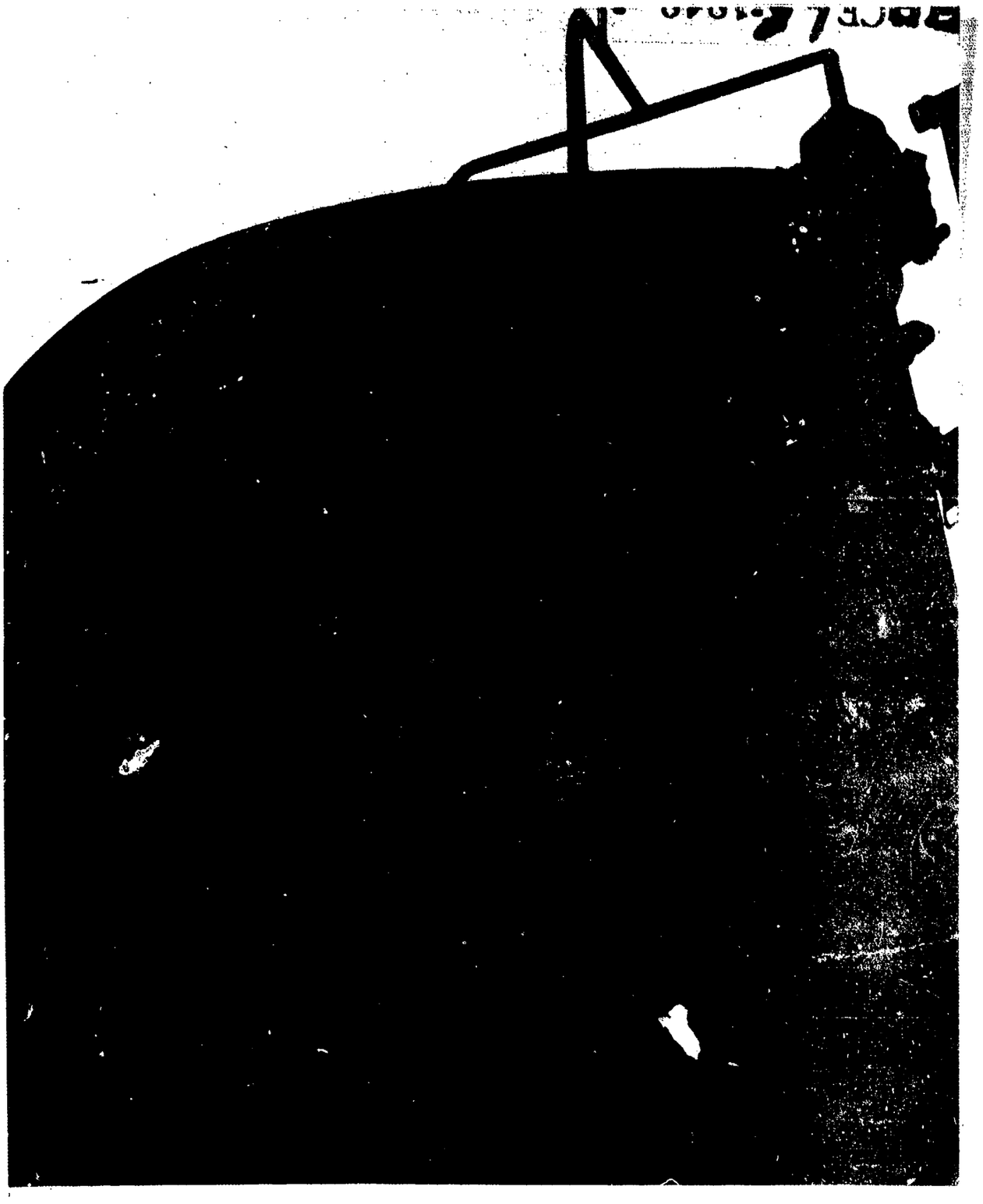
AA-CR-79-1815-6. Demolished ward room pantry bulkhead and door main deck, frame 60, port.

AA-CR-65-1848-12. Blast damage to inboard bulkhead of wardroom pantry, main deck, frame 60, port.

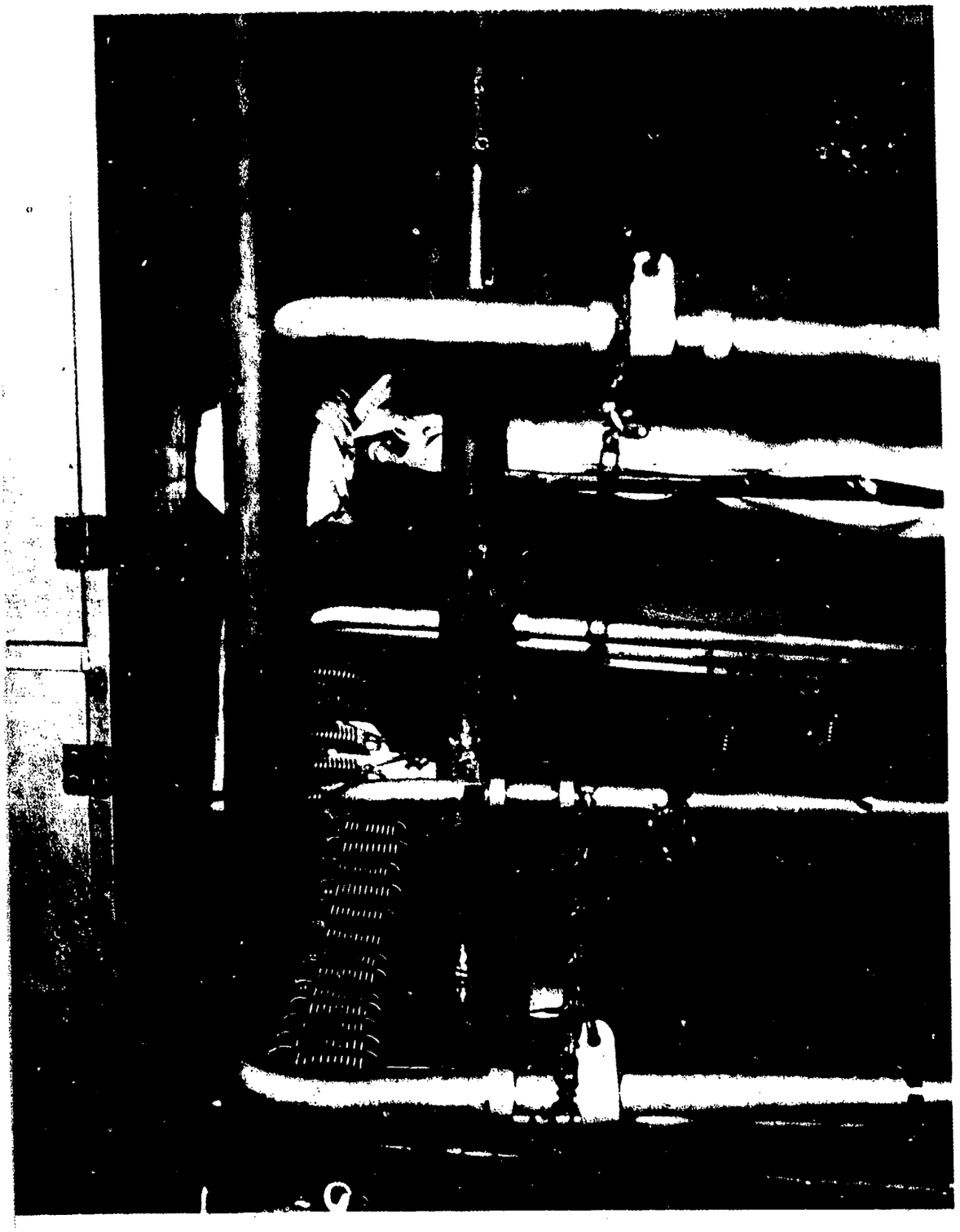
AA-CR-65-1849-1. Blast damage to after bulkhead of provision issue room, main deck, frame 59, centerline.



AA-CR-65-1849-5. Life raft. Top of deck house, frame 140, starboard. Note burned area in way of lashing and blast damage to wood platform.



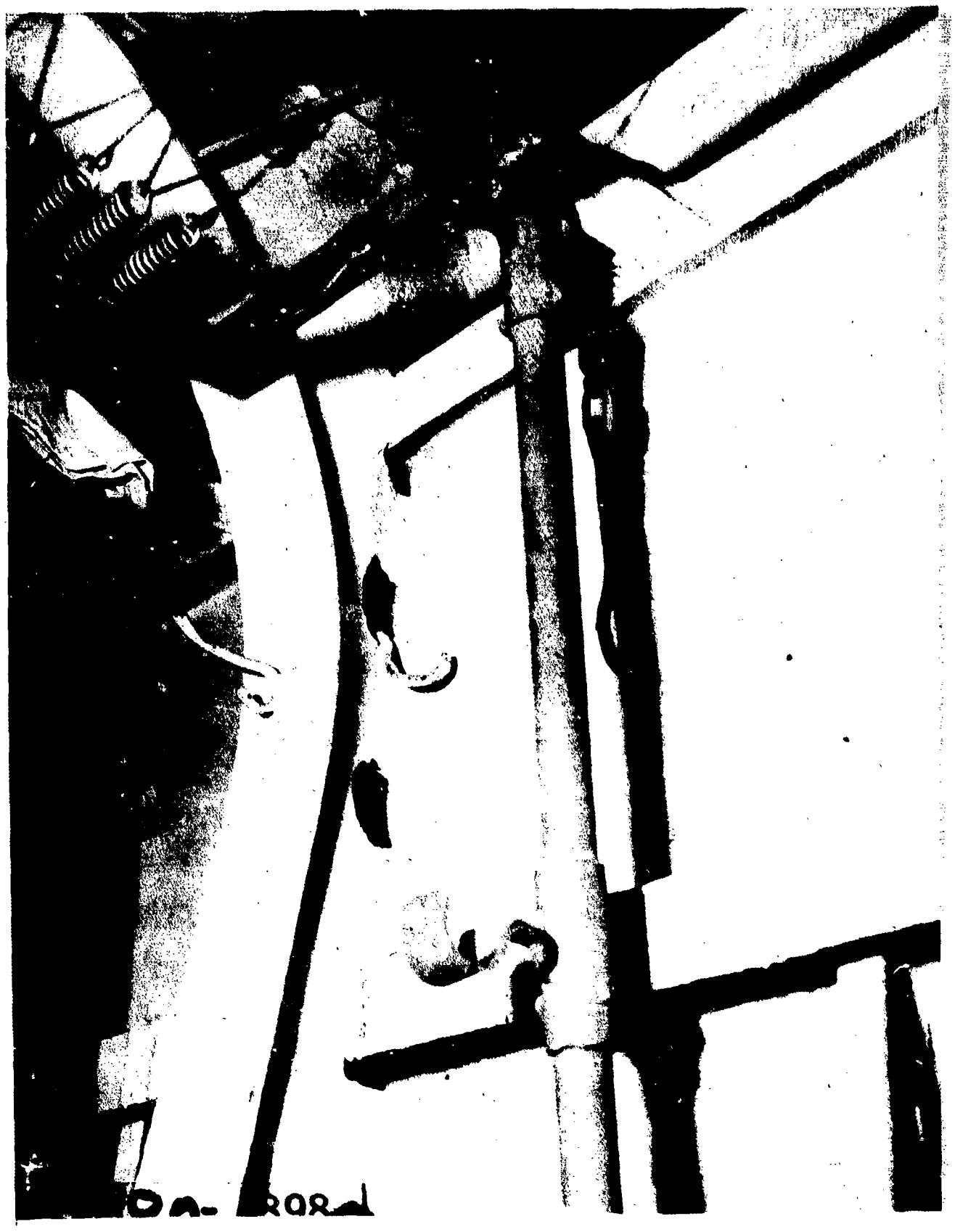
AA-CR-1848-11. Scorched paint on 20MM gun shield, port side, frame 100.



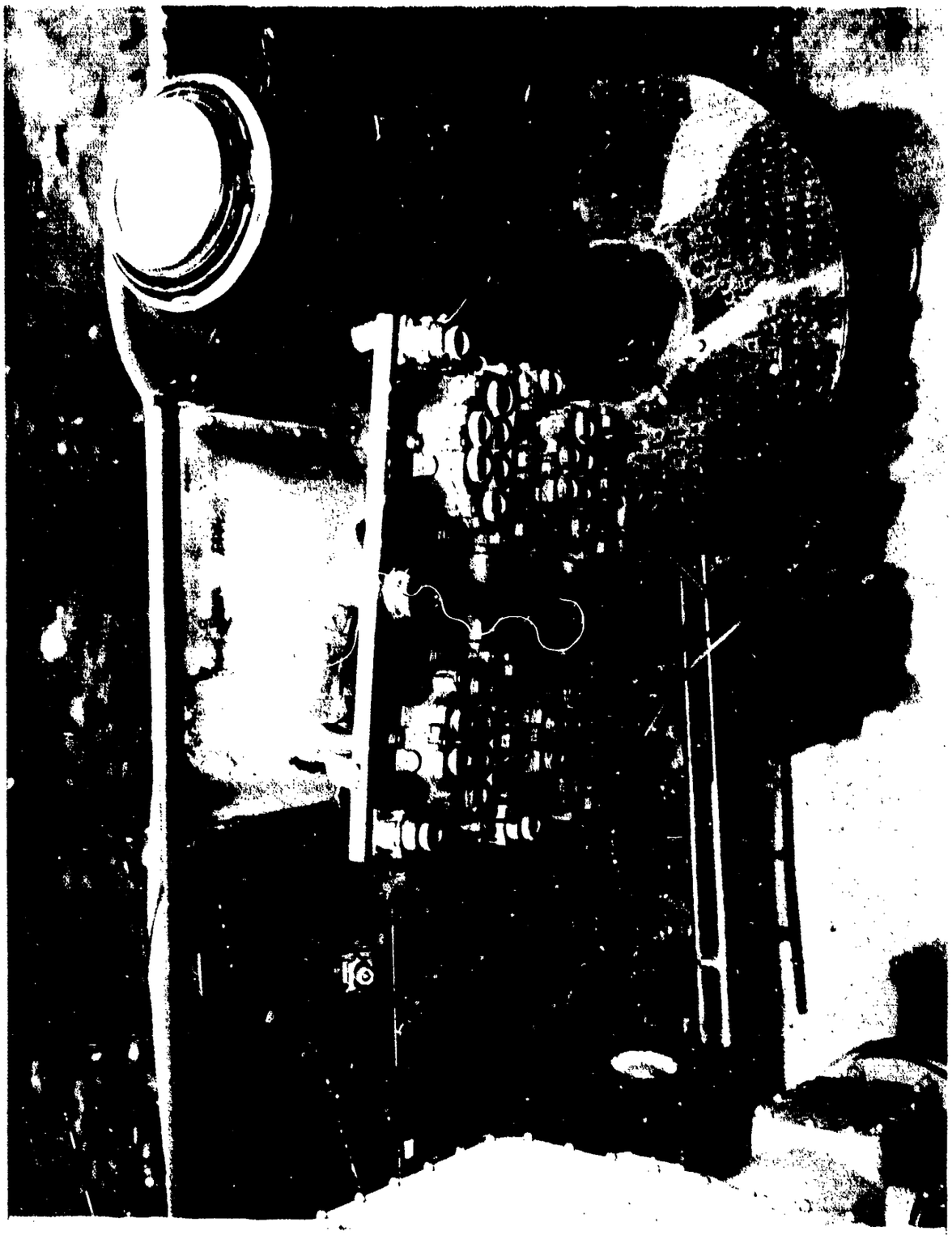
AA-CR-80-1898-9. Bent stanchion frame 171, port, first platform.

AA-CR-80-1898-11. Buckled web frame 171, starboard, in compartment D-210L.

AA-CR-80-1899-1. Damage to fiber glass insulation under main deck. D-210-L, frames 170 to 176.

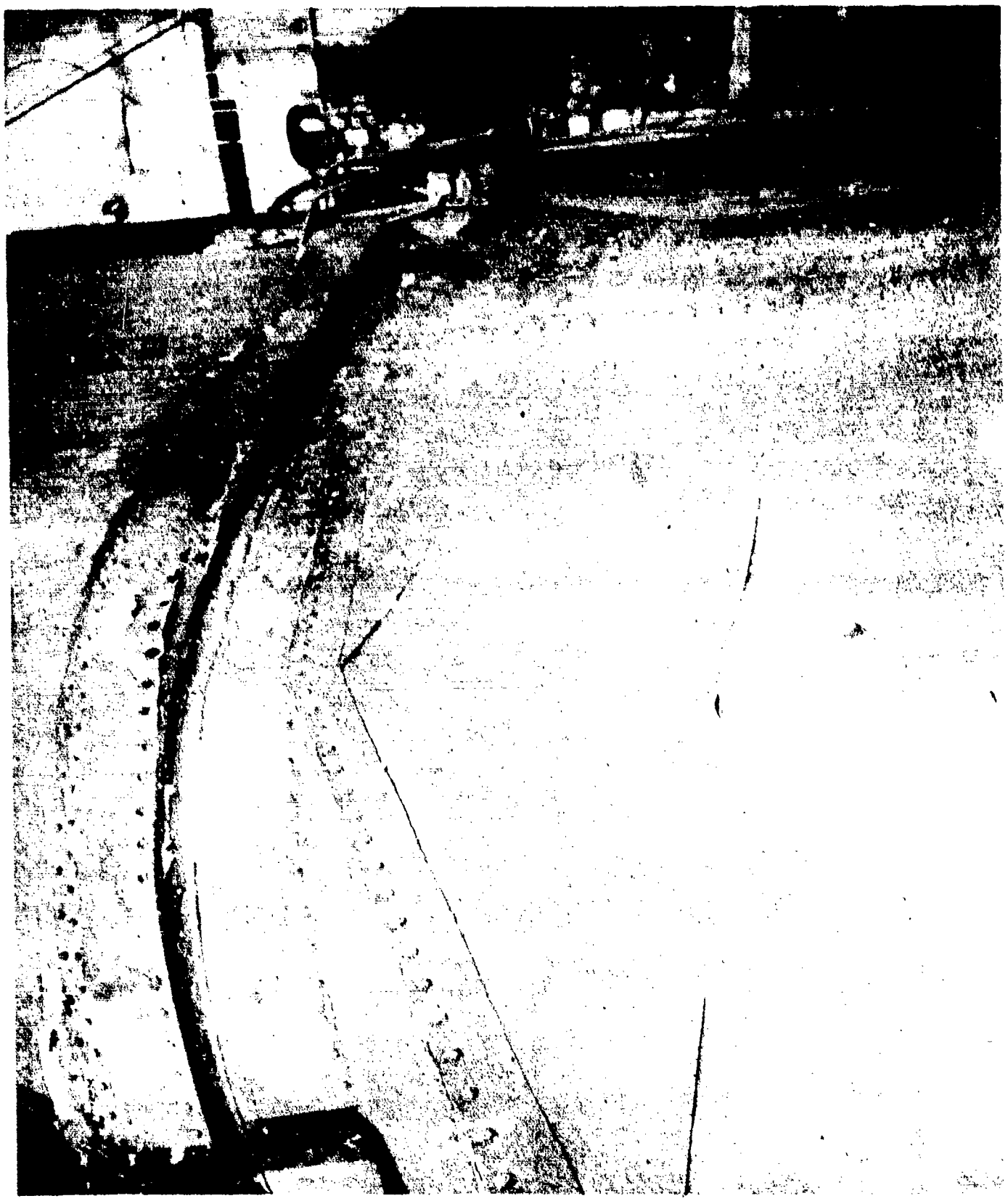


AA-CR-80-1898-10. Buckled web frame 175, starboard, in compartment D210L, slight aggravation of before test damage.



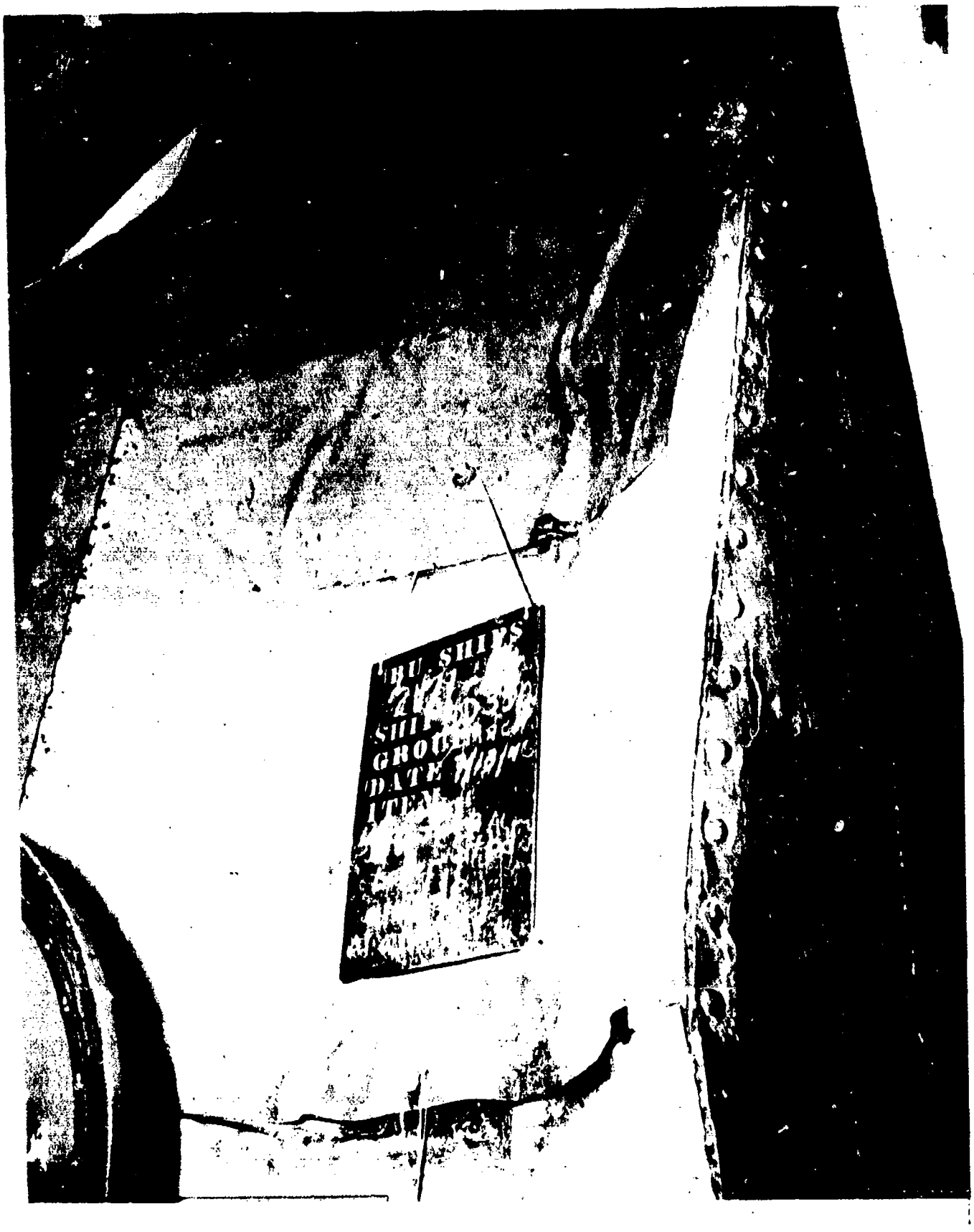
AA-CR-79-1815-8. Torpedo control panel mounting on port wing of bridge.

AA-CR-62-2171-4. No. 4 uptake, upper part viewed from above.



AA-CR-62- 171-5. Lower stack and upper uptake, starboard side.

AA-CR-62-2171-6. No. 4 uptake, lower starboard side.



AA-CR-62-2171-7. No. 3 uptake, lower starboard side.

AA-CR-62-2171-8. No. 3 uptake, starboard portion viewed from below.

AA-CR-68-1748-2. **After breeching, port side.**

APPENDIX

SHIP MEASUREMENT DIAGRAM

TEST ABLE

SHIP MEASUREMENT DATA

A. General Considerations.

A deck survey method was developed to determine the twist and longitudinal bending of each target vessel's hull girder resulting from an air or underwater burst of the atomic bomb. The procedure is as follows:

1. Select transverse sections. The maximum number of transverse sections used on any ship was six.

2. At each transverse section, select stations at which rod readings are to be taken. Center punch these stations in the deck. A minimum of five stations were used at each transverse section.

3. Establish throughout the length of the ship, by use of a surveyor's transit, a reference plane approximately parallel to the deck.

4. Take rod readings at every station on each transverse section.

5. Plot rod readings relative to a straight line representing the reference plane.

(a) Readings at each transverse section are plotted in order to obtain the configurations of individual sections and also to establish the relationship between sections.

(b) Readings at desired distances from the centerline are plotted in order to establish sheer lines. On most ships the actual readings are corrected for changes in sections resulting from local damage.

6. Repeat steps 3, 4, and 5 after the test using the stations established in steps 1 and 2.

7. Superimpose the after test plots on the before test plots in order to compare the conditions existing at the times of the two surveys.

The reference planes used in the before test and after test surveys are not necessarily parallel. Their relationship can not be accurately determined because bench marks established before the test may be affected by local damage or by changes in hull alignment. Therefore it is possible only to determine relative movement between sections. It is not possible to measure the absolute movement of any one section. The reference planes are disregarded after completion of the initial plots.

Twist of the hull girder is determined by superimposing one after test transverse section on the similar before test section and comparing the configurations of the remaining sections. Hog or sag is determined by superimposing before and after test plots of sheer.

The camber curves indicated in all plots are faired lines and do not show local deformation which may exist between the five station points.

B. Measurements.

1. Following the procedure outlines in paragraph A, general considerations the deck - survey of the USS RALPH TALBOT revealed negligible longitudinal bending. Therefore a profile of the sheer lines is not included in this report.

2. The before test survey was conducted at Pearl Harbor Navy Yard on March 28, 1946. Loaded conditions, temperature and sea conditions changed considerable between the before test survey and after test survey, the latter being conducted July 10, 1946 at BIKINI. These variations may have influenced somewhat the changes in the ships hull.

3. Twisting of the ships girder is shown in the plot of the transverse sections, page 97 , selected at frames 64-1/2, 95, 131 and 162. When the before test and after test plates were superimposed there was only slight change in the relative position of sections at frames 162 and 131. At frame 95 a twist of 3'' to port relative to frame 131 and at frame 64-1/2 a twist of 5-3/4'' relative to frame 131 resulted from the test. This amounts to approximately 49 minutes torsional relation (clockwise when viewed from aft) between frames 64-1/2 and 131, a distance of 122 feet; and 25 minutes torsional rotation between frames 95 and 131 a distance of 56 feet.

4. Three deck deflection gages were installed between the forecastle deck and main deck and three gages between the main and second deck. Their positions and negligible readings are recorded on page 98. A maximum compression of 1/2 inch was recorded at frame 173.

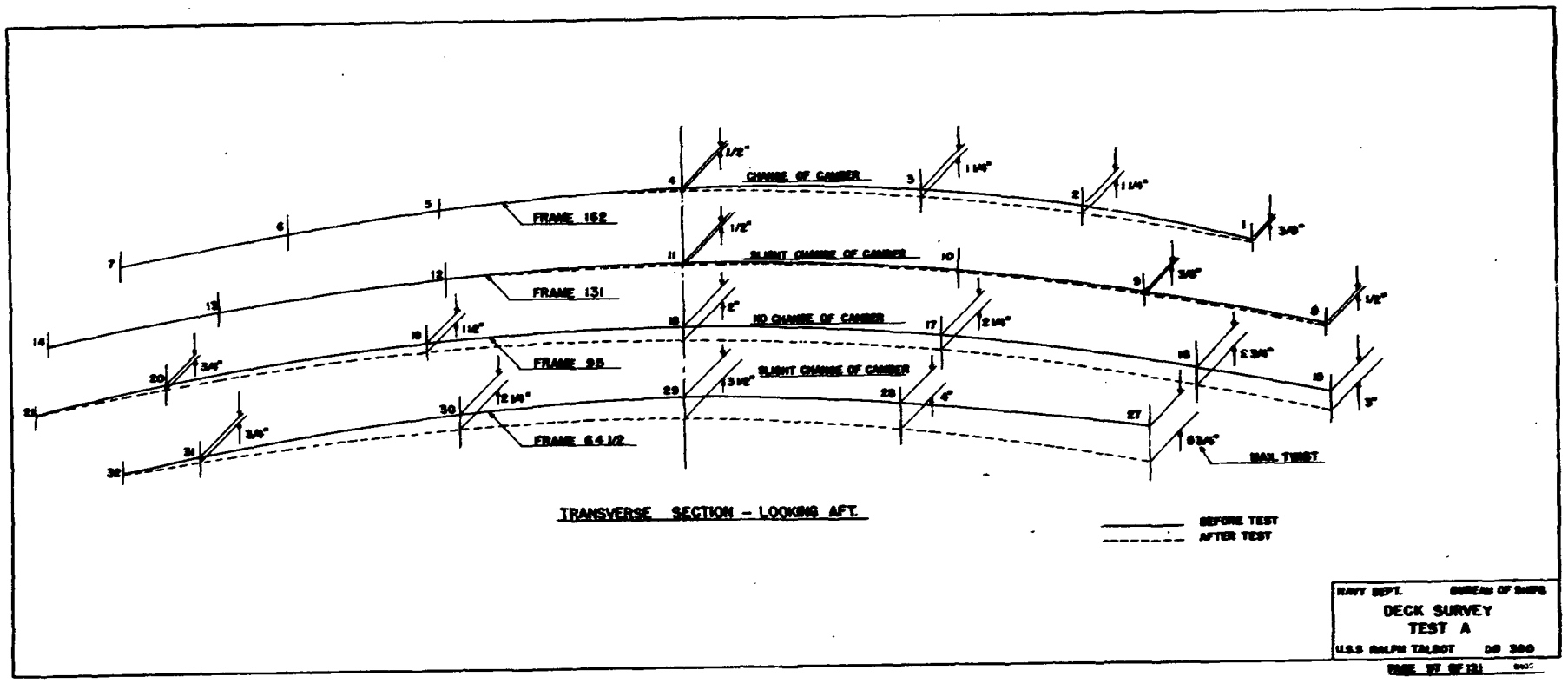
C. Summary of Changes in Shape of Hull.

1. Longitudinal Sheer - Negligible.

2. Shape of individual sections - Negligible.

3. Torsional rotation - 29 minutes in 122 feet.

4. Deck deflection gages - Readings negligible.


1/2"
CHANGE OF CAMBER
1 1/4"
1 1/4"
FRAME 162
3/8"
1/2"
SLIGHT CHANGE OF CAMBER
FRAME 131
3/8"
1/2"
2"
NO CHANGE OF CAMBER
2 1/4"
1 1/4"
FRAME 95
3/8"
3 1/2"
SLIGHT CHANGE OF CAMBER
2 1/2"
FRAME 64 1/2
4"
3/8"
MAIN THRUST
3"
TRANSVERSE SECTION - LOOKING AFT.
BEFORE TEST
AFTER TEST
NAVY DEPT. BUREAU OF SHIPS
DECK SURVEY
TEST A
U.S.S RALPH TALBOT DD 390

SECRET

DECK DEFLECTION GAGES

SHIP U.S.S. RALPH TALBOT (DD-390) **TEST** A

LOCATION			MAXIMUM COMP.	MAXIMUM EXP.	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄			DISTANCE	EXP. / COMP.	
10	MAIN	CENTER L.	0-0-1/8	NONE	NONE	NONE	NONE
19	"	"	0-0-1/16	"	"	"	"
36	"	"	NONE	0-0-1/16	"	"	"
147	2ND	"	0-0-7/16	NONE	0-0-7/16	COMP.	"
157	"	"	0-0-3/8	"	0-0-3/8	"	"
173	"	"	0-0-1/2	"	0-0-1/2	"	"

U.S.S. RALPH TALBOT (DD-390)

8400

APPENDIX

COMMANDING OFFICERS REPORT

TEST ABLE

REPORT # 11

COMMANDING OFFICERS REPORT

PART A. GENERAL SUMMARY

I. Target Condition After Test.

(a) The draft after test was the same as before test, Fwd. 11' 7" R, Aft. 12'0" R, Mean 11'9.5"R. There was no flooding and ship was on an even keel when reboarded.

(b) Structural Damage.

1. Superstructure.

Starboard and after bulkheads in all deck houses were slightly dished. Moderate damage was done to the stack and uptakes where the entire after and starboard surfaces were partially collapsed with moderate distortion, dishing and rupture of both inner and outer casing. The after bulkheads of the bridge superstructure suffered moderate distortion and dishing. The after bulkheads of the pilot house were badly dished. The doors through this bulkhead could not be opened by hand. The pilot house overhead had failed partially at riveted joints.

2. Hull.

No damage to the hull was noted except slight dishing of starboard shell plating from frames 70 to 90 above the water line.

(c) Operability.

All machinery, electrical, ship control, fire control, gunnery and electronics equipments were fully operational except as listed below:

1. 36" searchlight was operable but was resting on trunion plates having been blasted from trunion seats. Dome glass was shattered.

2. Main battery director roller path warped by blast causing bind in train.

3. 90% of antennas blown loose.

(d) Heat, Fires, Estimated Personnel Casualties.

There was no evidence of fires on board. Sudden intense heat scorched all exposed surfaces, blistered the paint and charred surfaces of mooring lines, fenders, boatfalls, signal halyards, life line coverings and snaking. It is estimated that the blast would have killed or seriously injured all exposed personnel on the starboard side of the vessel.

Engineers, magazine and gun crews inside closed compartments might have been affected by the blast shock, otherwise uninjured.

Pilot house and 5" gun director personnel definitely would have been injured by the blast.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The heat seemed to be intense but of very short duration (a flash). The heat was of sufficient intensity to scorch all exposed surfaces. However it penetrated only a very thin layer. It was noted that scotch tape effectively protected paint beneath it from scorching, the tape itself was scorched. All structures, regardless of material, withstood the heat. Only very light paper was scorched through.

(b) No fires or explosions took place.

(c) Shock.

The only evidence of shock was the shattering of the 36" searchlight lens and two ceramic insulators on foremast guys. However these items may have been broken by the blast pressure. There was no evident shock damage to machinery or other equipment.

(d) Pressure.

Sudden pressure was evidenced by all exposed surfaces. Dishing occurred on all exposed flat surfaces. Large structures (stack)

were distorted and partially collapsed. Light lockers and covering were ripped off completely.

(e) Effect Peculiar to Atom Bomb.

The wave form of pressure caused some surfaces to be dished and others demolished by wave guide action of covered funnel-shaped passageways which deflected and guided pressure waves along paths of least resistance.

III. Result of Test on Target.

(a) Effect on propulsion and ship control - none.

(b) Effect on gunnery and fire control.
Damaged electronics tubes in stable element knocked 5" gun director out of alignment.

(c) No effect on watertight integrity and stability.

(d) Except for possible blast and flash injury to personnel there was no effect on habitability. Radioactivity was negligible.

(e) Total effect on fighting efficiency.

The blast and flash effect undoubtedly present a serious danger to all exposed personnel. Blast also interferes seriously with strung antennas, the whip type, although bent and distorted, remain operable.

IV. General Summary of Impressions and Conclusions.

RALPH TALBOT was far enough away from the origin of blast to escape completely any serious damage. Large flat surfaces of light construction suffered moderate damage by blast pressure by dishing, partial collapse, distortion and failure of riveted and welded joints. Heavier surfaces (shell plating) suffered very slight dishing or no damage at all. Danger to exposed personnel was entirely flash burns and blast effects. Complete protection was afforded those in closed W.T. spaces of all but lightest material.

V. Specific Recommendations.

Streamlining will reduce appreciably the effect of exposed blast pressure. Fireproof paint should be used on all surfaces. Maximum closure of all spaces, above and below decks would reduce blast penetration to minimum.

Funnel shaped areas and open tunnel passageways should be avoided in construction because of the wave guide effect on the blast and its tendency to follow the path of least resistance.

PART C - INSPECTION REPORT

SECTION A - HULL

A. General Description of Hull Damage.

(a) Overall Condition of Vessel.

Except for partial collapse of the smokestack and weakening of the foremast, which had one starboard guy carried away, this vessel is completely operational.

(b) General Areas of Hull Damage.

1. All bulkheads on starboard side of vessel.
2. Shell plating starboard side.
3. Galley passageway.
4. Smokestack.
5. Foremast.
6. Bridge structure.
7. All exposed painted surfaces on starboard side.

(c) Cause of Damage in Each Area.

All damage was caused by blast pressure and sudden intense heat.

(d) No flooding of any type occurred.

(e) Residual strength of the stack is not very great. The stack joint at the top of the uptakes has failed for a distance of 8 ft.

Residual strength of the foremast is small. It would carry away in a moderate sea unless properly guyed.

There was no flooding thus no change in buoyancy.

The hull remains intact and watertight.

The ship is fully operable, no damage to operability occurred.

B. Superstructure (exclusive of gunmounts).

(a) Description of Damage.

1. Bridge Area.

The pilot house overhead, frames 61 to 63 was distorted and dished slightly. At frame 61 downward displacement was 3 inches, with permanent downward set of 2 inches. Two longitudinals on each side of the center line of overhead sheared rivets where joined to the forward and after bulkheads. They did not bend or crack.

The forward bulkhead of the pilot house was bulged out 2 inches. One glass port was cracked.

Both doors to the pilot house were badly dished as were the bulkheads in which doors are set.

The starboard flagbag (light sheet steel) was partially collapsed. Charthouse after bulkhead No. 68 was dished one and one-half inches.

Torpedo firing switch panel on port bridge wing was knocked off onto the deck. All bulkheads and exposed deck on the starboard side of the bridge were scorched black by sudden intense heat. Signal halyards were blown off, scorched and frayed but no evidence of fire could be found.

Bridge structure deck houses were all scorched and dished slightly on their after and starboard sides. The top six feet of vent duct from the galley, located just aft. of and below the signal bridge was blown off and the remainder of the duct partially collapsed.

2. Midship, deckhouse, mast and stack.

The fan house, frames 120 to 124, had its starboard and after bulkheads dished one to two inches. Paint was blistered and surface scorched black. Some effect noticed on battery locker, frames 103 to 106 and the starboard bulkheads of the machine shop, laundry and galley.

The smokestack and uptakes suffered the worst damage of all. The blast partially collapsed the after starboard part of the smoke pipe where the thin stainless steel plating was buckled to a depth of two feet from bottom to top. The horizontal riveted joint at the junction of the stack and uptakes failed for a distance of 8 feet. The rivets pulled through the CRS stack plating and remained fast in the uptake supports. The inner and outer stack and uptake casings were ruptured and torn in many places, most noticeable were rips at the corners on the uptakes and the under part of the uptakes where the flat surfaces were torn. The entire starboard surfaces of the uptakes were dished moderately. In some places the dishing was so severe that CRS plating failed and tore open.

The ladder up the forward part of the stack was torn loose at the bottom, and was badly distorted and twisted.

Paint on all the after and starboard surfaces of the stack and uptakes was scorched and blistered. One starboard guy supporting the foremast carried away and the remaining starboard guys were stretched to such extent that they offered no support. The mast itself was bent about 5 degrees to port at the level of the signal bridge and also bent forward about 3 degrees. The yardarm was distorted and twisted slightly by the blast. Only one whip antenna (BN) was blasted from the yardarm. The rest, although bent and twisted, were all operable. There was no damage done to navigational lights on the foremast. SC and SG antennas were intact and operated normally.

3. After deck house.

The starboard bulkheads of the after deck house were dished by the blast up to 2 inches in some places. Scorching and blistering of exposed painted surfaces was more severe here than in the forward areas.

It is noticed that on all bulkheads, the surface area immediately surrounding watertight doors suffered the most severe dishing. Invariably the doors and the surfaces in which they set were dished more than the bulkheads on either side. Besides the dishing effect, it was evident that the blast had pushed in the entire door and its frame in every case. This indicates that surface areas around closed W.T. doors are not as strong as plain flat bulkheads

(b) Causes of damage in each area.

All damage was caused by blast pressure.

(c) Evidence of fire.

No fire evidence.

(d) Estimate of relative effectiveness against heat and blast of.

1. Various plating thicknesses.

The thin CRS steel plating of the stack and uptake was easily torn through by the blast. No other bulkheads suffered more than moderate dishing. The effect of heat was not evident on any plating.

2. Various shaped surfaces.

All large flat surfaces were dished by the blast. Rounded and streamlined surfaces, except the stack, remained intact.

4. Aluminum Structures.

The superstructure is almost entirely of aluminum construction. Bulkheads were dished to a greater extent. For example the starboard bulkhead on the bridge, made of aluminum, was dished moderately while the steel bulwark nearby and parallel to it was intact.

Aluminum supports and beams cracked and ruptured while steel members were bent slightly. Aluminum joints in the pilot house failed when steel securing bolts and rivets ripped completely through the plating. Aluminum rivets were sheared off and not pulled through.

(e) Constructive Criticism.

Extensive streamlining of all surfaces would minimize blast effect. Exposed fittings, such as ladders, lockers, and ready service boxes, unless heavily secured will be ripped off by a blast. All these fitting should be removed or streamlined into adjoining surfaces.

Welds throughout the ship held while numerous riveted and bolted joints failed. Panels and plates must be placed flush against bulkheads to

prevent a blast from blowing them loose by getting behind them.

C. Turrets, Guns and Directors.

(a) Protected mounts.

All protected gun mounts were intact except gu #2, the after bulkhead of which was dished 1 1/2 inches. This mount was energized and trained 090° true. It received the blast full on its after bulkhead. The dishing caused two small space heaters to be knocked from their supports on the interior surface of the bulkhead. In all other respects the mount was intact.

(b) Unprotected Mounts and Gun Crew Shelters.

Guns 3 and 4 were intact but both shelters had starboard and after bulkheads dished slightly. Paint on the starboard and after sides of both guns and gun crew shelters was scorched black and blistered by sudden intense heat.

(c) Directors and Rangefinders.

1. The mark 33 gun director, located on top of the bridge structure, suffered slight distortion of its roller path. This was effected by the force of the blast pushing against the director's after bulkhead. This bulkhead was dished about 1 1/2 inches.

2. All instruments in the director were intact except the stable element mounted in the after section. The internal elements of two thyratron tubes were broken by the blast. After replacing these tubes the stable element operated normally.

(d) Constructive Criticism of Design.

Distortion of the director roller path was due to insufficient strength and support of the roller path. It's diameter is too small.

1. A minimum of fire control instruments should be mounted in the director (plotting room solves this).

2. Complete streamline of director surfaces will minimize blast effect.

3. Blast protection for all exposed gun crews is a necessity. Although damage to gunnery equipment was slight, the casualties to personnel would have been heavy. Strong light steel streamlined shelters should enclose all exposed gunnery personnel to deflect and stop the blast pressure wave.

D. Torpedo Mounts and Depth Charge Gear.

(a) Torpedo mounts.

1. All torpedo gear was intact.

2. There was no evident damage to warheads or air flashes. Protection to torpedo is adequate.

3. Paint on starboard mounts was scorched and blistered.

4. Some type of blast shield is necessary for the protection of exposed tube personnel. A streamlined "dog house" similar to those originally installed on after tube mounts of 2100 ton DD's would give required protection.

(b) Depth Charge Gear.

1. All equipment was intact except that depth charges on fantail racks and starboard projectors were scorched.

2. The depth charge casings offered ample protection from heat and blast.

3. Blast shelter for exposed personnel is a necessity.

E. Weather Decks.

(a) The deck plating aft. of frame 160 and around the access hatch to crew's living space D-210L dished 1 1/2 inches but sprung back leaving a

permanent dish of about 1/2 inch.

The forecastle deck was dished 1/8 inch. All weather decks on the starboard side were scorched black and blistered.

Life line coverings and snaking along starboard side were scorched, frayed and in many areas were blasted loose or stripped away. Although scorched, no lines showed evidence of burning.

(b) All damage was caused by blast pressure. Weather decks were useable throughout ship, and except for trash and litter were intact.

(c) Mooring and towing fittings were undamaged. Boat handling gear was scorched. No boat was on board during test. Life rafts were intact except Number One raft stowed on the starboard side aft. The lattice-wood bottom of this raft was splintered and broken by the blast.

F. Exterior Hull (above waterline.).

(a) There are some small dished areas on the transom and slight evidence of additional dishing from frames 180-183 and 125-128. These areas, all above the waterline on the starboard shell plating, were already dished some before the blast.

Painted frame numbers, bow number, draft marks, and side paint was scorched and blistered.

(b) All life line stanchions on the starboard side were bent about 10 degrees to port and 5 to 10 degrees forward by the blast pressure wave. Starboard 20 and 40 mm sheet metal sponsons were partially collapsed. The sponsons on the port side were bulged and distorted.

G. Interior Compartments (above waterline).

(a) Compartments on the starboard side of the ship suffered slight dishing of their starboard bulkheads and overheads. Frames in

the dished area were distorted or bent a small degree. One longitudinal "I" beam in the overhead of living space D-210L was bent wnen the deck above it dished and caused a vertical supporting stanchion to buckle.

The galley passageway area suffered moderate damage due to wave guide effect produced by this covered area. The blast wave travelled up the starboard side into the passageway and was deflected by the after bulkhead of the wardroom, (this bulkhead was dished) 90 degrees to the left. Following the path of least resistance the pressure wave moved athwartships dishing the forward galley bulkhead and collapsing the after bulkhead of the issue room. The constricting effect of this narrow athwartships passageway projected the blast against the pantry bulkhead which was completely demolished. At this point the blast was again deflected 90 degrees to the left and dissipated itself running aft, down the port galley passageway and out onto the weather deck. During this transit light lockers and fixtures in the passageways were ripped off.

(b) There was no damage to interior compartments except the wardroom where the small pantry serving window in the after bulkhead was blown off and thrown into the table leaf cabinet causing a large dent in the after side of this locker.

(c) All access doors on the starboard side opening out onto weather deck were dished by the blast. The doors and bulkhead framing around the doors were dished far more than plain flat surfaces close by.

(d) Equipment within compartments was damaged only where mounted on or against dished bulkheads. Distortion of tables desks and breakage of phones and other small mounted objects by falling upon the deck was all the damage that occurred.

(e) There was no evidence of fire.

(f) No reduction in watertight subdivision or habitability or utility of compartments resulted.

H. No armor deck fitted.

L. Interior Compartments (below waterline).

All intact.

J. Underwater Hull.

(a) The underwater hull was intact except for a very small leak in D-312 V caused by loosening of packing around the rudder post.

K. Tanks.

All intact.

L. Flooding.

(a) There were no areas of major flooding.

(b) D-312 V, the after peak tank, was flooding very, very slowly because of the leak around the rudder post.

M. Ventilation (exclusive of blowers).

(a) Damage and Causes.

1. Ducts.

All exposed vent ducts all were partially collapsed because of their light construction. The top six feet of the galley exhaust duct was blown off.

2. Closures.

Except for slight dishing by the blast no damage was done.

3. The vent supply to C.I.C. carried away; otherwise habitability was not affected.

(b) There was no evidence that vent ducts conducted heat, blast, fire or smoke below decks.

(c) Lightly constructed vent ducts should not be exposed on the weather decks. All ducts should be protected by running them inside compartments with only their supply or exhaust openings exposed to the weather and blast pressure.

N. Ship Control.

(a) Damage to ship control and causes.

1. Bridge area.

Exposed stations on the starboard side (signal bridge, pelorus, lookouts) were subject to the full force of the blast. Undoubtedly their personnel would have been killed or injured. Except for dishing and bulging of pilot house bulkheads this area was intact. The personnel in the pilot house would have been subjected to considerable damaging pressure when the overhead and after bulkheads were dished..

2. C.I.C.

Starboard bulkheads slightly dished, otherwise intact.

3. Gyro compass equipment.

Intact.

4. Steering gear.

Intact.

5. Interior Communications.

Intact.

(b) Constructive criticism of ship control systems.

Adequate except that streamlining of bridge structure would reduce blast damage.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control positions. The after bulkhead of the Mark 33 gun director was dished about 2 inches. The Mark 14 sight on after 51 director controlling after 40 MM mount was scorched.

2. Protected spaces.

Intact.

(b) List of stations having insufficiently protection and estimated effect on fighting efficiency of the loss of each.

1. Torpedo directors.

Loss of operators would require that torpedo be fixed by local control.

2. Depth charge control station on bridge.

Casualty to personnel would require local control of release of DC's from racks and throwers.

3. Depth charge stations.

All exposed personnel would be casualties.

4. After Mk 51 director.

Exposed personnel would be casualties requiring local control of after 40 MM mount.

5. After 40 MM, exposed 5 inch gun mounts and all 20 MM gun crews and torpedo mount crews. All personnel were exposed to the full effect of the blast and probably would have been casualties. This would have materially reduced the fire power of this vessel.

(c) Fire control equipment withstood the blast quite well. Personnel, however, would probably have been casualties in all exposed stations. Blast protection is necessary.

P. Ammunition behavior.

(a) All ammunition was intact. None was affected in any way by the heat or blast. Stowages secured sufficiently were well protected except 20 MM ready service lockers on after deck house. These lockers are constructed of light sheet metal. The top of two lockers were ripped off by the blast.

Q. Ammunition handling.

Intact.

R. Strenght.

Except for the dishing effect of the blast on flat surfaces there was no evidence of strain in hull plating, failure of structural supports or failure of gun machinery foundation.

S. Miscellaneous.

(a) Heat damage variations of paint.

This vessel is painted solid Navy Blue, formula 5-N. All exposed surfaces were scorched black and blistered.

The special paint used in painting frame numbers on deck and sides was blistered and peeled. Instead of scorching black this paint was turned white by the heat.

Machinery and Electrical.

Damage to machinery and electrical equipment was so slight that the use of an itemized outline is unnecessary.

All damage is listed below:

1. The air passages in the stack were reduced by the partial collapse of the inner and outer stack casing. Numerous holes and vents in the casing have reduced the efficiency of the smokestack.

2. Lead readings show that the port L.P. turbine rotor jumped .007 inch. Another set of readings show the rotor to have returned to normal position after the blast.

3. A one inch cooling water line from the firemain to the fuel oil service pumps in the forward fireroom carried away during the blast; failure occurred at a 90 degrees elbow. The fitting was badly corroded.

4. About 20 percent of the installed light bulbs throughout the ship were shattered by the blast.

5. In the fan house (deckhouse under search light platform) the bakelite back board of an engineroom vent supply blower controller and also an exhaust blower controller were broken. The controller boxes were mounted on the starboard bulkhead two feet apart. Dishing of the bulkhead by the blast caused the damage.

6. The top of the storage battery in the emergency diesel room was cracked slightly.

7. The 36" searchlight was inoperable. It had been blown off its trunion mounting and was resting on the mounting plates. Two men were able to force the searchlight back onto its trunions restoring normal operation. The dome glass was shattered. Reflector was intact. In all other respects the searchlight was intact.

Fuel oil, water, steam, electrical and drainage systems were intact.

Boiler casings, brickwork, tubes and drums were intact.

Engineering machinery suffered no damage.

The emergency diesel generator continued to operate normally until it ran out of fuel two hours after the blast.

PART B

A. General Description of Electronics Damage.

(a) Overall condition.

Ninety percent of the ship's electronic equipment was in normal operating condition after the blast. However, the ship's immediate electronic efficiency was reduced to about 60 percent of normal due to damage to topside antenna system. Immediate repair by ships personnel could improve this to 80 percent in three hours.

(b) Areas of major damage.

Communication antennas, waveguide and antenna cables sustained the major portion of the damage to electronics equipment. Minor damage was not concentrated in any particular area or compartment.

(c) Primary cause of damage in each area.

All significant damage was due to the pressure wave following the blast. No effects peculiar to an atomic bomb were observed.

(d) Operability of electronics equipment.

1. Radar.

Although all radar equipment was in satisfactory operating condition after the blast, the efficiency of CIC was reduced to 70% of normal due to damage to the SG waveguide and loss of the BN antenna.

2. Radio.

All low frequency receivers and transmitters were in satisfactory operating condition after the blast. Loss of antennas reduced the immediate communication efficiency to 50 percent of normal. However, enough of the antennas were in evidence to allow ship's force to restore communication facilities to 90% of normal in three hours.

3. Sonar.

Sonar equipment was in satisfactory operating condition after the blast.

4. Loran.

Not aboard this ship.

(e) Types of equipment most affected.

Damage was not significantly concentrated in any particular type of equipment.

B. Fire Control Radar. (MK4)

All units intact and in operating condition.

C. Surface Search Radar, (SGa)

Waveguide damaged, severely attenuating signals; antenna scorched; otherwise normal.

D. Air Search Radar, (SC-3)

Transmitter torn loose from shock mounts; operates normally.

E. Radar Repeaters, (VC-1).

Normal operating condition.

FandG Not aboard this ship.

H. IFF Equipment (BL, BN, BK).

BN antenna blown off; otherwise normal.

I. Communication Transmitters (TBK, TBL, TAJ).

Normal operating condition except antennas.

J. Communication Receivers.

Normal operating condition except antennas.

K. Communication Antennas.

Two out of three transmitting antennas, and three out of five receiver antennas demolished. Strain and entrance insulators broken.

L. Radio Transceivers, (TBS, MN, MAN, An/ARC-1).

In normal operating condition. SCR-608 and AN/ARC-4 thrown to deck from bulkhead mounting. No damage to antennas.

M. Sonar Echo Ranging. Normal operating condition.

N. Sonar Echo Sounding. Normal operating condition.

O. No Loran gear installed on board this ship.

P. Power Supplies.

All motor-generators, filters and batteries normal.

Q. No Television or Teletype equipment installed on board this ship.

R. Test Equipment. Normal operating condition.

S. Instrumentation. Black box intact.

T. Telephone Equipment.

About 20 percent of telephone handsets ripped from bulkhead mounting.

U. No radio direction finders installed on board this ship.

V. Spare Parts.

No damage to spare parts including tubes in any location.

Defense Special Weapons Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398

TRC

9 April 1997

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OMI/Mr. William Bush

SUBJECT: Declassification of Reports

The Defense Special Weapons Agency (formerly Defense Nuclear Agency) Security Office has reviewed and declassified the following reports: + ST-A

AD-366748	XRD-65
AD-366747	XRD-64
AD-366746	XRD-63
AD-376826	XRD-60
AD-376824	XRD-58
AD-376825	XRD-59
AD-376823	XRD-57
AD-376822	XRD-56
AD-376821	XRD-55
AD-366743	XRD-54
AD-376820	XRD-53
AD-366742	XRD-52
AD-366741	XRD-51
AD-366740	XRD-50-Volume-2
AD-366739	XRD-49-Volume-1
AD-366738	XRD-48
AD-366737	XRD-47

TRC 9 April 1997

SUBJECT: Declassification of Reports

AD-366736	XRD-46
AD-366735	XRD-45
AD-366723	XRD-37
AD-366721	XRD-35
AD-366717	XRD-31-Volume-2
AD-366716	XRD-30-Volume-1
AD-366751	XRD-68-Volume-2
AD-366750	XRD-67-Volume-1
AD-366752	XRD-69
AD-366744	XRD-61.

All of the cited reports are now **approved for public release. Distribution statement "A"** now applies.

Ardith Jarrett

ARDITH JARRETT
Chief, Technical Resource Center

Completed
1 mar 2000
B.W